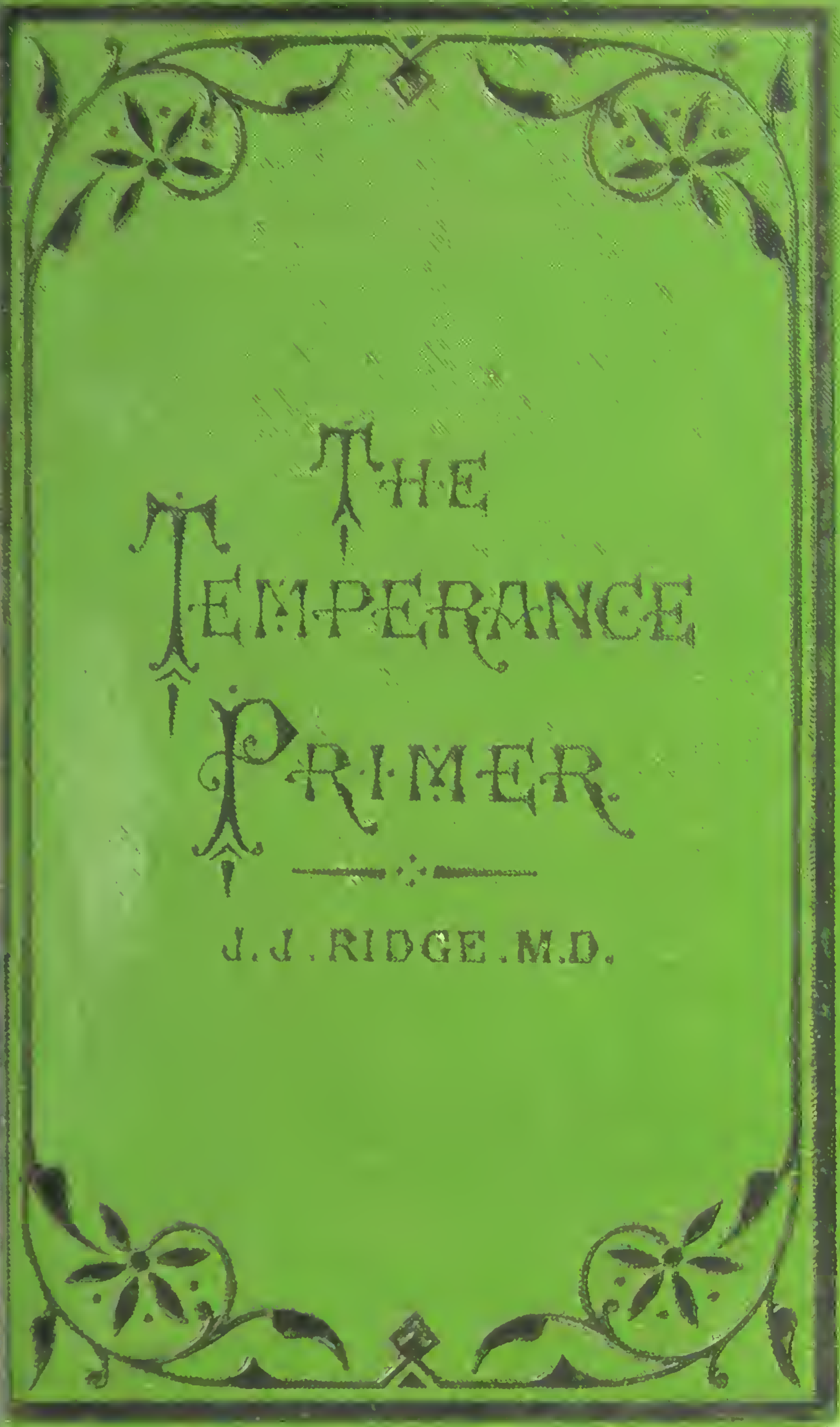

THE TEMPERANCE PRIMER

J. J. RIDGE. M.D.

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THE
TEMPERANCE
PRIMER.

AN ELEMENTARY LESSON BOOK,

DESIGNED TO TEACH

THE NATURE AND PROPERTIES OF ALCOHOLIC
LIQUORS, AND THE ACTION OF ALCOHOL
ON THE BODY.

BY

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PREFACE.

It is not without careful consideration that it has been determined to publish this Primer. There are now to be found in many school-books reading lessons which give information on the manufacture, composition, and effects of Alcoholic liquors; there are also primers or elementary books of anatomy and physiology: there is, moreover, the excellent Temperance Lesson Book of Dr. Richardson. It would therefore seem at first sight that the field was sufficiently covered. A brief outline of the aim and scope of this Temperance Primer will, however, best indicate the gap which it is intended to fill. It is hoped that the book will be self-explanatory on the subjects treated of.

As Alcohol is a complex chemical substance, containing the elements Carbon, Hydrogen, and Oxygen, an attempt has been made first of all to give the learner an idea of the nature and uses of these elements in relation to the subject under consideration. In this way it is hoped that he will obtain an intelligent idea of the origin of Alcohol by means of fermentation. Again, in order that it may be understood in what way Alcohol affects the digestion, the circulation of the blood, and the mental processes, chapters on these subjects are inserted—as far as is necessary to explain the changes produced. Thus it has been supposed that the reader knows little or nothing of the subject, but may by attentive reading, both alone and in the family without a guide, and especially with the assistance of a qualified school-teacher, gain such an insight into the action of Alcohol on the system as to enable him to understand and appreciate more advanced works.

A word or two on the special features of the plan may be desirable. It is so arranged as to form a series of reading lessons, and questions for examination are appended to each chapter. When it is read for the first time some portions may, if desired, be omitted without interference with the continuity of the plan, and these portions (sometimes only words) are enclosed in square brackets. On this first perusal, too, it may be found well to omit the more difficult examination questions, reserving these for another time.

The value of an early acquaintance with the action and tendency of that which has so great an influence on human life and happiness is now all but universally granted. I trust that this little book will be a means of removing some of the difficulties which at first seem so formidable to a young beginner in endeavouring to understand terms and facts about it which more advanced students and educated people are apt to forget that they do not know. By thus learning the non-necessity and injurious actions of Alcoholic Liquors they will no longer be able to plead the excuse of ignorance, should they be drawn away and enticed thereby, and the blame of their failure will no longer be justly attributed to the silence of those whose knowledge and experience has taught them the nature and the influence of Intoxicating Drinks.

J. JAMES RIDGE.

Carlton House, Enfield,
February, 1879.

THE
TEMPERANCE PRIMER.

CHAPTER I.

What the Air is made of.

If you were told that the air is made of *gas,* or, rather, of two or three gases mixed together, you might perhaps think it strange. You know that *gas* gives us light at night time, and so you may think that gas is a kind of fire. You know that the air is not fire, how then can it be gas? But think a moment! If the tap of the lamp is turned on you hear a rushing sound. That is the gas escaping, and soon you can smell it, because it has *mixed with the air* in the room. Do not let much escape. Now, if you put a lighted match to it, it will burn. You can understand that gas was there before, though you could not see it, and that gas of that kind will burn.

There are many kinds of gas. Most of them cannot be seen, just like the gas we get from coal: some will burn and some will not. The air which we breathe is chiefly made up of two gases mixed together, just as we can mix milk and water; there is also a very little of a third kind of gas in the air. The names of these gases are Oxygen,* Nitrogen,* and Carbonic Acid.* The most important of these is the Oxygen, without which we should die, and no candle or fire would be able to burn.

The Oxygen can be taken away from air, and then only Nitrogen and Carbonic Acid are left. This is how it can be done.

Experiment I.—Take a piece of card large enough to cover the mouth of a tumbler. Stick a little pin or tin tack through the middle of the card, and put it on the table with the point sticking up. Now put on the tin-tack a very small piece of a candle. Light the candle and place the tumbler over it. The flame soon grows dim and then goes out, and the tumbler is filled with smoke mixed with two of the gases of the air. Only two now; because the Oxygen under the glass has been used up while the candle burned, Carbonic Acid has been formed, and the Nitrogen, which was there before, is there still.

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* For pronunciation of this and other words followed by an asterisk, see Appendix, at the end of the book.

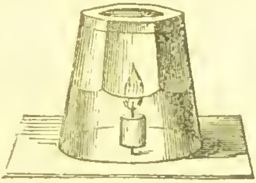


FIG. 1.

You cannot light the candle again unless you admit some fresh air, or Oxygen, because a candle will not burn without Oxygen. Try.

Experiment II.—First turn the tumbler the other way up, keeping the card closely over it. Now light a match. Then slide the card a little to one side, and put the lighted end of the match into the tumbler through the opening. It goes out because there is no Oxygen there.

I said you could not live if there were no Oxygen in the air. When animals breathe they use up the Oxygen, and take it away from the air. If a boy were put under a large glass, so that no fresh air could get in, most of the Oxygen would after a time disappear, and a great deal more Carbonic Acid would be found there instead, having come from the boy's breath. He would soon fall down and die for want of Oxygen to breathe.

You cannot see the Carbonic Acid in the tumbler, but you can prove that it is there very easily. You want some lime-water. This you can buy or make. If you wish to make it you must get a small piece of burnt lime from a builder. Take a piece the size of a walnut, break it up to powder, and put it into a large bottle: fill the bottle with cold water.

Shake the bottle several times in one day. During the night the lime will settle at the bottom, and then you can pour off the clear lime-water into another bottle. It is called lime-water because there is some lime dissolved* in the water, just as a lump of sugar will dissolve, or disappear in a glass of water. Sugar is said to be soluble* in water, but it is much more so than lime is; that is to say the same quantity of water will dissolve a great deal of sugar and only a little lime. Marbles do not disappear if they are put into water; they are insoluble.

Experiment III.—Now slide the card a little to one side as before, and pour in about a tablespoonful of the lime-water. Slide the card back and hold it while you move the tumbler round and round so as to rinse the glass. You see that the lime-water has become milky. This milky look is produced by a white powder floating in the water. The white powder is called carbonate* of lime, or *chalk*, which is insoluble in water. The chalk is formed by the Carbonic Acid which was in the glass first dissolving in the water and then combining,* that is, joining with the lime in the lime-water.

The Carbonic Acid is very easily dissolved in the water, but the Nitrogen of the air is not, so this is left behind. Remember, then, that *when anything is burned, and also when we breathe, the Oxygen of the air is used up, and Carbonic Acid is formed.*

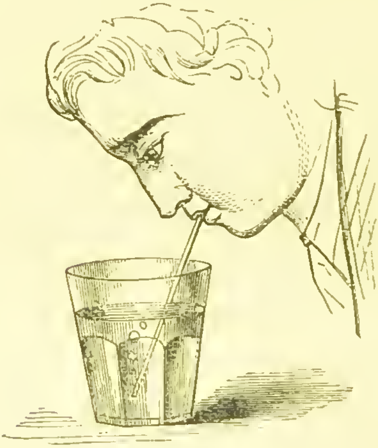


FIG. 2.

Experiment IV. Take a tumbler and fill it half-full of lime-water. Now take in breath and then blow gently through a glass tube or a straw for a short time.

Soon the lime-water will turn milky, because carbonate of lime is made, just as when you added the lime-water to the air in the tumbler in which the candle had been burned.

EXERCISE I.

1. What is air made of?

2. What change does a burning candle make in the air?

3. What is formed when we breathe?

†4. How can you get rid of two kinds of gas which are in the air?

†5. How can you prove that Carbonic Acid is present in the breath of animals?

---

† Rather more difficult questions, suitable for older children or when going through it a second time.

CHAPTER II.

On Oxidation and the Composition of Food.

You have been told that when a candle burns, the Oxygen in the air is used up and Carbonic Acid is formed. The atoms or little bits of Oxygen unite with little bits of Carbon in the tallow or wax of the candle. Now Carbon is black; soot, charcoal, and blacklead are different kinds of Carbon. But the candle is not black, and yet there is Carbon in it. The Carbon in tallow is combined, or joined with two gases, namely, Hydrogen* and Oxygen. These three things are called *elements;* so tallow is said to be made of three elements: Carbon, Hydrogen, and Oxygen. There is not enough Oxygen in tallow to make Carbonic Acid with the Carbon, but when the tallow burns, more Oxygen from the air joins the Carbon and makes Carbonic Acid. If there were less Oxygen in the air then there would not be enough to combine with all the Carbon. But I can show you that there is real black Carbon in the white tallow, thus :—

Experiment V.—Light a candle and hold a plate over the flame for a few seconds just touching it: now you see some Carbon on the plate: the cold plate cooled the flame, and so some of the Carbon was not changed into Carbonic Acid.

†[Chemists represent Carbon by the letter C, and Oxygen by the letter O. C is called the *symbol* * of Carbon, and O the symbol of Oxygen. When the candle burns two atoms, or bits, of Oxygen combine with one atom or

---

† This and similarly bracketed paragraphs may be omitted at discretion, and reserved for a second perusal.

bit of Carbon, and this combination is written thus:—

$$\overbrace{\mathrm{C}}^{\text{Carbon.}} + \overbrace{2\mathrm{O}}^{\text{Oxygen.}} = \overbrace{\mathrm{CO_2}}^{\text{Carbonic Acid.}}$$

CO_2 (*read* thus, C O two) is called the formula* of Carbonic Acid.]

The three elements, Carbon, Hydrogen, and Oxygen, make up a great number of very different substances; they differ because some contain more Carbon, some more Hydrogen, and some more Oxygen. I will mention a few:— Fat, oil, cotton, paper, starch, sugar, honey, treacle, and alcohol or spirit of wine. All these substances will burn because they all contain Carbon for the Oxygen of the air to combine with.

But while the Oxygen is combining with the Carbon to form Carbonic Acid, you may wonder what becomes of the Hydrogen. Other atoms of Oxygen in the air join with the Hydrogen, and when these two elements combine together they form *water*.

[The symbol of Hydrogen is H, and in order to form water *one* atom of Oxygen combines with *two* atoms of Hydrogen, thus :—

$$\overbrace{2\ H}^{\text{Hydrogen.}} + \overbrace{O}^{\text{Oxygen.}} = \overbrace{H_2\,O}^{\text{Water.}}$$

(*read* thus, two H plus O equal H two O)].

It is easy to show that water is formed as well as Carbonic Acid, when these things are burned.

Experiment VI.—Light a candle and hold a cold tumbler over the flame with the mouth downwards so that the edge is just level with the flame (Fig. 3). In a few seconds you will see that the inside of the glass has become steamy from the water which has risen from the burning candle, and settled on it like dew. It will wet your finger if you rub the inside of the glass.

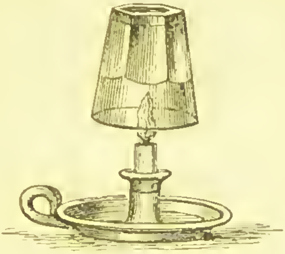


FIG. 3.

When Oxygen combines with another element we say that that element is *oxidized.** So when Carbon is oxidized it forms Carbonic Acid; when Hydrogen is oxidized it forms Water. [A substance which contains two or more elements combined together is called a *compound*, as water, tallow, &c.] When tallow is oxidized both Carbonic Acid and Water are formed, because the tallow contains both Carbon and Hydrogen. When a candle is burning and the Oxygen is rapidly combining with the Carbon and Hydrogen, as we have seen, we say that *oxidation* is going on rapidly.

Whenever two elements, such as Oxygen and Carbon, or Oxygen and Hydrogen, combine or join together to form something else, *heat* is always produced. That is why the flame of the candle is hot. So remember that *oxidation always produces heat.*

But though oxidation always produces heat it does not always produce light, that is, a flame, or fire. The amount of heat produced depends upon the rate at which the oxidation is going on. It is very rapid when fire is produced; that is to say, a great deal of Oxygen combines with some other elements in a very short time. Remember, then, that *the quicker the oxidation, the greater the heat.*

Although the three elements, Carbon, Hydrogen, and Oxygen, combined together in different quantities, form a great many things, there are more than sixty other elements, or kinds of matter, which unite to make many more substances. But these three, Carbon, Hydrogen, and Oxygen, with one other, called *Nitrogen,** are the most common. If to these four you add *Phosphorus* * and *Sulphur* * you may say that all the things which we eat or drink are chiefly made of two, three, four, five, or all of these six elements combined together in different quantities and different ways.

[The symbol of Nitrogen is N; of Phosphorus, P; and of Sulphur, or brimstone, S.]

You were told that fat and sugar only contain Carbon, Hydrogen, and Oxygen; the *lean* part of meat contains Nitrogen and Sulphur besides. The following substances also contain Nitrogen in addition to Carbon, Hydrogen, and Oxygen, and are therefore called *nitrogenous* substances*:—the white of an egg, which is made of *albumen;** and peas and beans, which contain a great deal of vegetable albumen: jelly and glue, which are chiefly *gelatin:** cheese, which is mostly *casein:** and *gluten,** which is found in wheat and other seeds. Our brains and nerves contain a great deal of Nitrogen, and, in fact, so do *almost all animal substances* except fat. Fat and the vegetable substances which do not contain Nitrogen, such as paper, sugar, &c., are called *non-nitrogenous* substances, which means *not* nitrogenous, that is, without Nitrogen.

EXERCISE II.

1. What is Carbon· like? Mention some things which are made of it altogether, and some which are partially made of it.

2. What happens when Carbon is burned?

3. What is water made of?

4. Write down all the elements mentioned in the lesson.

† 5. How can you prove that there is Carbon and Hydrogen in a piece of wood?

† 6. What is oxidation? Give instances.

† 7. Mention four things containing Nitrogen and four which do not. By what name is each of these classes called?

† 8. Give the formula of Carbonic Acid and of Water.

† 9. What is the most common way in which heat and flame are produced; and why do we sometimes get heat without flame, and sometimes both?

CHAPTER III.

On Heat-giving and Flesh-forming Foods.

It is possible to show you that there is Carbon in white sugar without burning it.

Experiment VII.—Take five or six lumps of loaf sugar. Break them up into small pieces, put them into a tall glass, and place that on a plate. Then pour on them a teaspoonful of water, and a little while afterwards three or four times as much *oil of vitriol*,* which is strong *sulphuric acid*.* [The formula for this acid is H_2SO_4, which is read thus: H two, SO four.] You must be very careful not to spill or touch any, even with a spoon, because it will burn your clothes or hands. Very soon the sugar turns black and swells up; it becomes hot and gives off some steam. This black stuff is the Carbon which was in the sugar [The formula for this kind of sugar is $C_{12}H_{22}O_{11}$ (*read* thus, C twelve, H twenty-two, O eleven). You may say that there are of Carbon 12 atoms, and of Water (H_2O) 11 atoms, since H_2O multiplied by $11 = H_{22}O_{11}$. The strong sulphuric acid has a very great affinity or attraction for water; so the water and the acid combine together, causing heat, and the Carbon is left alone.]

You have now learned two ways in which sugar may be destroyed, namely, by burning it and by the action of strong sulphuric acid upon it. In the first case, the elements of the sugar are oxidized, producing Carbonic Acid and Water; in the second, they are simply torn asunder, forming Carbon and Water. There is a third method of destroying sugar more commonly followed than the other methods, namely, by eating it.

When sugar is eaten it is destroyed in the body in just the same way as when it is burned, that is, it is *oxidized*, and produces heat. The oxygen of the air goes into the body through your lungs when you draw in your breath; and, when you breathe out, Carbonic Acid and Water come away. You have been shown that Carbonic Acid is present in your breath by Experiment IV., in Chapter I., page 14; the water you can see come away as a cloud on any cold, frosty morning, or by breathing on your slate. This Carbonic Acid and Water come from the *slow combustion** or *oxidation* of sugar, and other kinds of food containing Carbon and Hydrogen. It is this slow combustion which keeps you warm.

Even when you are at rest and asleep some food is being burned up, but when you walk and run much you become hotter and more food is consumed. If you had nothing to eat, your body would become cooler every day, and at last you would die of cold. But if you were starved in a hot room, you would not get cool so quickly and would live longer.

One of the chief uses of food, then, is to furnish heat or warmth to the body by being oxidized. Some kinds of food will produce more heat than other kinds. Fat, or any sort of oil, gives most heat. This is the reason that people who live in very cold countries are very fond of oil and grease, and take a great deal. They like a good feast of blubber, as the fat of the whale is termed, and will eat tallow candles with glee. People in this country prefer to eat more fat in winter than in summer.

Sugar will produce almost as much heat as fat, though not quite. Next to sugar comes starch, and food which contains it. Starch forms the greater part of many things we eat: it is found in all vegetables, but especially in potatoes, rice, wheat, oatmeal and barleymeal, arrowroot, sago, and tapioca. It is easily shown that there is starch in wheaten flour.

Experiment VIII.—Take a little flour of wheat, put it into a small piece of muslin, and twist it up: now squeeze it about with your fingers in a small basin of water: by doing this the starch is washed away and a sticky mass is left in the muslin: this mass is *gluten.* If you let the milky water stand a short time the *starch* will settle at the bottom.

Starch consists of little bodies more or less round or oval. The starch-grains of wheat are round, and about 1,000 would lie side by side in an inch. Those of rice and potatoes are larger and of an oval shape. Starch does not contain any Nitrogen. [Its formula is $C_{12}H_{20}O_{10}$.] Remember, then, that *fat, sugar, and starch, which are non-nitrogenous substances—that is, do*

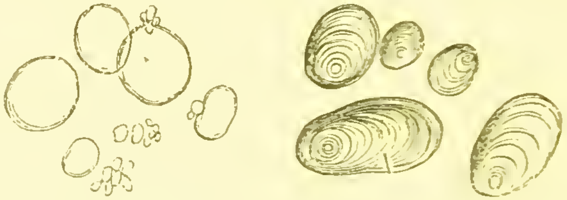

Wheat-starch Grains. Potato-starch Grains.

FIG. 4.

not contain any Nitrogen—are burnt up in the body; they keep us warm, and enable us to move about and do all kinds of work.

These non-nitrogenous kinds of food which are burned up in the body to create heat and keep us warm are sometimes called "*heat-givers.*" Our bodies have always to be kept at very nearly the same heat. When you are quite well there is very little change indeed in the warmth or heat of your body. You may *feel* hot at one time and cold at another, but if you had a small thermometer,* by which we can *measure* the heat exactly, and put it in your armpit next to the skin, it would always rise to about the same point, marking 98 degrees on the scale. If you put the end of the thermometer into your mouth for a short time, you would find the difference in the heat of the inside of your body, in very hot weather and in very cold weather, even less than the slight change that there is in the warmth of the skin, or outside of your body.

If you have to keep a room warm, you know that when the weather gets colder you must put more coals on the fire to burn. So you will use up the coals in the coal-cellar faster, and the cellar will have need to be filled more often. So when it is cold, and your bodies begin to get colder, the millions of tiny fire-places inside you burn up the store of food more quickly, so as to create more heat, and therefore you have to take more heat-giving food. It is chiefly in the muscles, or flesh, by which you move your body and limbs, that this food is burnt up or oxidized. Therefore, when you want to get warm, you have to run and jump about, and thus more heat is produced. If you sit still you become cold because the cold air is cooling you, and the heat is not being made quickly enough inside. You must put on more clothes to keep the heat in, and work the muscles to make more, and will need more food, or fuel to burn. Ploughboys are very fond of fat bacon, because they are walking about all day long; the fat is quickly burned in the muscles, as they use them so much.

You could not live if you had only sugar to eat, nor only fat, nor starch. If you had a railway-engine and fed it with water and coals, you could get up steam and travel many miles, but every now and then it would want more water and more coals. The coals are like the fuel-food, the heat-giving food. They furnish the heat required to work the engine. But you know that the engine will not work for ever; it wears out. The coals will not mend the engine, you need iron to do that. So your body wears out by degrees when you do work or move about, and you cannot mend your body with sugar, or fat, or starch. It is the muscles which wear out most quickly, the red flesh which you can see in any butcher's shop. This flesh contains Nitrogen, and, therefore, to mend or make it you need food which contains Nitrogen—*nitrogenous* or *flesh-forming* food.

Meat, cheese, milk, peas, beans, oatmeal, wheat-flour (and therefore bread), all contain Nitrogen, some more, some less. So it would be possible to live on meat (as many South American Indians do), or milk (as babies do), or oatmeal (as some Scotchmen do), or even on bread. All these things contain some heat-giving as well as flesh-forming food, but most of them contain too much either of one sort or the other. Therefore, in order to have just enough fuel to give heat to the body and do work with, and just enough stuff to mend the body with as it wears out, without having too much of either, you want to take some food which is chiefly or altogether heat-giving and some food which is chiefly flesh-forming, that is to say, you require a *mixed diet.* So we take together bread (chiefly heat-giving), and cheese (chiefly flesh-forming); meat (chiefly flesh-forming), with potatoes and bread (chiefly heat-giving); broad beans (chiefly flesh-forming), and bacon (if fat, chiefly heat-giving). Oatmeal more nearly contains a proper quantity of both these necessary kinds of food than bread does, and if mixed with milk is a perfect food. Milk itself contains fat (butter) and sugar, which are heat-giving, and caseine (cheese or curds) which are flesh-forming, but rather more of the latter than a man requires who has done growing; it just suits the babies whose bodies have to be made larger quickly and who therefore require much flesh-forming food.

Exercise III.

1. What is sugar changed into when it is completely burned? and what when it is eaten?

2. What gases enter our lungs when we breathe and what come out?

3. Name some heat-giving foods, and some flesh-forming foods.

4. What elements do each of these kinds of food contain?

† 5. How can you prove that there is Carbon in sugar?

† 6. How does exercise make us warm?

† 7. Describe starch and where it is found.

† 8. What is the advantage of a *mixed* diet? Give examples.

CHAPTER IV.

On Sugar, Malt, Yeast, and Beer.

SUGAR is found in many trees, plants, and vegetables. There are several kinds. The sugar which we use every day, both "moist" and "white," is called *cane-sugar* [sucrose*], because it is found in the sugar-cane. But a great deal of it comes from beet-root, and the same kind of sugar is also found in the sap of the maple and in Chinese sugar-grass. The next most important kind of sugar is called *grape-sugar* [glucose*]. It is found in grapes and in other sweet fruits. There are three varieties of it. One kind [dextrose*] is that in sweet fruits; another [lævulose*] is in acid fruits, and this will not form crystals,* as the first kind does;

the third kind [maltose*] is found in sprouting seeds. Besides grape-sugar, there is another which is found in milk, and is therefore called milk-sugar [lactose*].

[The composition of these sugars is as follows:—

$$\begin{aligned} \text{Sucrose} &= C_{12}H_{22}O_{11} \\ \text{Lactose} &= C_{12}H_{24}O_{12} \\ \text{Glucose} &= C_{12}H_{28}O_{14}.] \end{aligned}$$

Grape-sugar can be made from starch or cane-sugar by boiling them for some time in weak acid and water. Starch does not seem much like sugar, but it is formed of the same three elements, namely, Carbon, Hydrogen, and Oxygen, but contains less Hydrogen and Oxygen than sugar does. You know that Hydrogen and Oxygen combined together form water; if sufficient of these two gases to make four atoms of water is *combined* with one atom of starch we have grape-sugar.

$$[\overbrace{C_{12}H_{20}O_{10}}^{\text{Starch.}} + 4\overbrace{(H_2O)}^{\text{Water.}} = \overbrace{C_{12}H_{28}O_{14}}^{\text{Grape-sugar.}}.]$$

Starch can also be made into grape-sugar in another way. When a seed is sown, or is moistened with water and kept in a warm place, part of it decays and changes into a substance called *diastase.* This substance acts on the starch in the seed, and changes it into sugar. If it is mixed with starch and warm water, it can thus change 2,000 times its own weight of starch.

This is the change which takes place when barley is "malted," that is, is made into *malt.* Malt is made in this way:—1. *Steeping.* The grains of barley are soaked in water for forty-eight hours. 2. *Couching.** The moist barley is put into heaps; it gets warm, and begins to sprout or grow; as it grows *diastase* is formed. 3. *Flooring.* It is then spread out in thin layers on a floor, so that it may not become too hot, and is turned over by men every day for from ten to twenty days, generally fourteen, according to the heat of the weather: thus, you see, malt cannot be made without working on

Sunday. During all this time it is sprouting and the diastase is changing part of the starch into grape-sugar and part into dextrin,* or British gum. 4. *Kiln-drying.* The sprouted barley is then dried over a fire in a kiln to stop its growing any more: if it is to be used to make porter or stout it is slightly burned, so as to make it brown. 5. Lastly, the buds, or sprits, are rubbed off, and the malt is then ready to be used by the brewer to make beer with.

Of course, in making barley into malt, a good deal of nourishment is wasted; 100 pounds of good barley will make only about 80 pounds of malt. The object of malting barley is really to make sugar, from which Alcohol may afterwards be made.

Alcohol is made from the grape-sugar in malt by *fermentation*, by which the sugar is split up into Alcohol, Carbonic Acid gas, and Water.

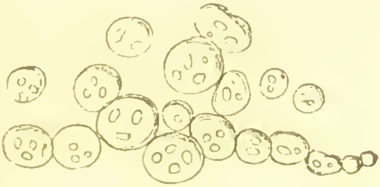
[The following formulæ will explain it:—

$$\overbrace{C_{12}H_{28}O_{14}}^{\text{Grape-sugar.}} = \overbrace{4(C_2H_6O)}^{\text{Alcohol.}} + \overbrace{4CO_2}^{\text{Carbonic Acid.}} + \overbrace{2H_2O}^{\text{Water.}}.]$$

It is often said that alcohol is *in* the barley, but you see that the barley has first to be *changed* into sugar, and then the sugar is changed into alcohol: if the fermented sugar is left alone, the Alcohol will, in a few days, all change into vinegar; therefore it is just as absurd to say that Alcohol is in barley or fruit as to say that there is vinegar in them.

The sugar is split up into Alcohol and Carbonic Acid by means of a ferment. Diastase is a ferment, something which can cause one kind of substance to change into another if it is in contact with it. Diastase causes the starch to join with water and become grape-sugar. The ferment which causes the sugar to break up again into Alcohol, Carbonic Acid and water is called *yeast*.

Yeast consists of millions of little round bodies floating in water. These are shown, magnified, in Fig. 5. They grow and multiply in warm sugar and water. Alcohol is formed, and Carbonic Acid, which comes away in a great many bubbles, making much froth. Syrup, which is sugar dissolved in water, will not change into Alcohol without the action of a ferment: if it be shut up in bottles, so that no air and no yeast-cells floating in the air can get to it, it will never change; but it must be corked up while boiling to destroy any ferment which may have got into it before.


Yeast Cells.
FIG. 5.

Beer is made from malt by the following steps:—1. *Crushing.* This is done by passing the malt between rollers. 2. *Mashing.* The malt is steeped in hot water for a few minutes to dissolve the sugar [maltose] which is present in it. The water having dissolved the sugar is called *sweet wort*, and is then drained off very carefully, leaving the *grains* behind. Of eighty pounds of malt only about forty pounds will dissolve in the water; the other forty pounds are sent away to feed the cows and pigs. 3. *Boiling.* To the sweet wort some hops are then added, and it is boiled for an hour or two: sometimes other bitter substances are put in instead of hops, such as gentian and quassia.* 4. *Cooling.* The hops are allowed to settle, and then the clear liquor is drawn off and allowed to cool. 5. *Fermenting.* After cooling sufficiently some yeast or barm* is added to produce fermentation. It is kept gently warm, and allowed to ferment for some time, longer in winter than in summer. 6. *Cleansing* or *Fining.* When the fermentation has gone on long enough the yeast is skimmed off, or else the beer is put into casks with the bung-hole uppermost, and the yeast floats out through it: in these casks it cools and settles. A good deal of solid matter falls to the bottom of the cask, and is known as *barrel-bottoms*, and the ale or beer becomes clear.

In making the malt into beer still more nourishment is thrown away or destroyed. By the diagram you can see the amount of solid matter which is left after malting and brewing.

Starting with good barley ...	100 lbs.
By making it into *malt* it becomes	80 „
By dissolving it in water to make *sweet wort* and throwing the grains away it becomes	40 „
By *fermentation* the solid matter becomes	20 „
By *fining* it becomes	10 „

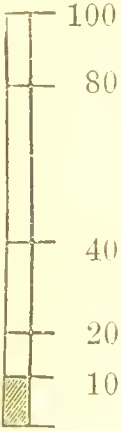


Fig. 6.

The 100 pounds of barley make about 18 gallons of ale, so that, in an 18-gallon cask, there are only 10 pounds of solid matter, and this is not nearly the most nourishing part of the barley, in fact no one would think of eating it as food.

EXERCISE IV.

1. Mention four kinds of sugar and where they are found.

2. Mention some changes which take place when a seed grows?

3. How is malt made?

4. How is beer made from malt?

†5. How can grape-sugar be made (*a*) from cane-sugar, (*b*) from starch? What changes sugar?

†6. What substances are in barley (*a*) before malting, (*b*) after malting?

†7. Describe the change in sweet wort produced by fermentation?

†8. Describe yeast.

†9. What loss of weight takes place (*a*) in malting barley, (*b*) in making beer?

CHAPTER V.

On Beer, Wine, and Spirits.

We have now to learn what there is in ale and beer after they have been made. These are called *malt liquors*, but there are several kinds, such as ale, stout, porter, &c. The difference between these which you would notice first is the difference in their colour. The malt which has been used to make stout and porter has been heated more than that used in making ale; some of the sugar has been burnt and has turned brown. This burnt sugar also gives a different flavour to the beer. The other things contained in all these malt liquors are nearly the same, but in some kinds there is more water, more spirit, or more solid matter than in others. In 1,000 pounds weight of beer you would commonly find about

Fluids, 947½ pounds	885	pounds	of	Water,
	60	,,	,,	Alcohol,
	2½	,,	,,	Acid (chiefly vinegar and Carbonic Acid),
Solids, 52½ pounds	45	,,	,,	Heat-giving food,
	5	,,	,,	Flesh-forming food,
	2½	,,	,,	Salt, and matter like salt.

You may reckon, then, that nearly nine out of every ten parts of beer are simply water. If it were not for this water no one could or would drink the beer. It is only because there is water in beer that beer-drinkers do not have to drink water as well as beer with their food. But there are other things dissolved in the water or mixed with it, and for the sake of these many people drink a great deal more water than they really need. *Alcohol,* or spirit of wine, is the chief substance mixed with the water in beer. Ales and beers contain from three to eight parts of Alcohol in 100: so that in an average pint of ale there is about half a wineglassful of pure Alcohol, or one part in twenty. If the beer is boiled all the Alcohol is soon driven out of it, and then the greatest lover of beer would refuse to swallow it. But this boiled beer would not make anybody drunk. Besides the Alcohol there is also a little acid or vinegar, and some Carbonic Acid gas. If the beer is poured out and allowed to stand a short time, the Carbonic Acid escapes, and leaves the beer *flat*, or stale. If it stands a long time exposed to the air the Alcohol gradually turns to vinegar and the beer becomes *sour*.

In twenty ounces of beer by weight there is about one ounce of solid matter. Of the solid matter which would be left after boiling the beer quite dry about nine out of every ten parts are capable of giving heat by being burnt in the body. [A very little of this is *Sugar*, and the rest is *Dextrin*, or British gum, half-way between starch and sugar.] Of the one ounce of solids not quite one out of ten parts is flesh-forming substance, and this more in name than in reality, because it is very different from real flesh-forming food.

It is very clear then that a man cannot live on beer alone. Because (1) there is too much water; (2) he could not get enough solid heat-giving matter, to do hard work with, without taking so much alcohol along with it as to weaken and intoxicate him; (3) even if he went on working with the heat-giving food for a few days, there is not enough flesh-forming matter to repair or mend his muscles with as they waste away; hence he would at last become too weak to work. But though there is *some* nourishment in beer it is very little. In a pint of ale there would only be as much food as two tea-spoonfuls of moist sugar and a piece of cheese not so big as a small marble: or not more than half the quarter of a penny loaf. So a penny loaf would give you at least as much nourishment for work as a gallon of ale.

1 Loaf costs	1 penny,
1 Gallon of Ale costs ...	24 pence.

Two shillings would buy enough flour to make about eighteen pounds of bread,—four quartern loaves and a half.

[When beer becomes stale, sour, and unsaleable, it is sent back to the brewer, who mixes it up with some new beer, by which the new beer is made to taste like old ripe beer, and the drinkers of it are deceived.]

Sometimes common salt is put into beer, so that the people who drink it may be made thirsty, and buy more.

Wine is made by causing the juice of grapes to ferment. The grape-juice, when ripe, contains a good deal of grape-sugar. The grapes are first trodden by men with naked feet, or pressed in a vat by means of a screw, and the juice which flows out is sweet, and does no contain any alcohol; it is called "*must,*" or new wine. If it is allowed to stand in a warm place, very soon it begins to ferment, and some of the sugar changes into Alcohol and Carbonic Acid. In a few days this fermentation stops:

the juice, which was thick at first, now settles and becomes clear; then the clear wine is drawn off, and put into casks or bottles to keep it from the air. If the air can get to it, in a few days all the wine becomes sour, because the Alcohol turns to vinegar. There would be no intoxicating wine if men did not do something to make it keep. It is shut up in bottles for this purpose. Very often more Alcohol is added to the wine when freshly made, so that it may not turn sour: this is called *fortifying* * it.

If wine is red, it is because the skins of red grapes have been left in the *must* when it was fermenting. But very much wine sold as port, sherry, and champagne, &c., is not made from grapes at all, but by mixing various things together.

British wines, such as ginger, currant, orange, elderberry, gooseberry, cowslip, &c., are all intoxicating; they contain Alcohol as a result of their fermentation.

Grape-juice and the juices of other fruits can be kept from fermenting by boiling them, and shutting them up so that no cells of yeast, § floating in the air, can get into them.

The amount of Alcohol in wines varies, both in different kinds and in different bottles of the same kind of wine. But, for the most part, port and sherry are the strongest of the commonly used wines, champagne and claret are about half the strength of port, and British wines and cider rather less.

Besides Alcohol, wines contain some acids, both tartaric * and acetic * acids (vinegar), some sugar, substances like salt, and also that which gives each its own flavour. Champagne contains nearly as much sugar as beer does, sherry and port about half as much (some kinds much less), and claret has scarcely any.

Spirits contain much more Alcohol than beer or wines, and therefore less of them will make people drunk. There are several kinds, which are made from different substances. Of course in all cases Alcohol is first formed by fermentation. If wine, such as sherry, is put into a glass vessel (*a*, Fig. 7) and boiled, the Alcohol rises very soon, as a kind of invisible vapour or steam, and passes down the tube till it comes to a cool part; then it settles in little drops, which flow together and run out at the end into the other vessel or receiver (*b*), which is kept cool by a wet cloth. This process of making vapour by heat and then cooling it is called *distillation*,* and the Alcohol or spirit which collects at the bottom of the receiver is called *distilled spirit.* The flavour of the sherry comes over with the Alcohol, but the sugar and

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§ Chapter IV., page 39.

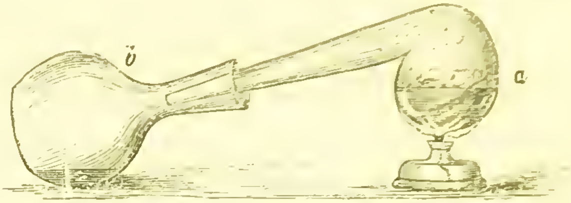


FIG. 7.

acid, and most of the water, are left behind. Distillation is the same process as takes place when the hot sun dries up a pond, the water of which rises into the air as vapour, condenses to form a cloud, and then falls in drops of rain. No one thought of this plan of separating the Alcohol from the water and other things, until about the year 1050. As this spirit is added to wines to increase their alcoholic strength, it follows that wines are now much more intoxicating than they used to be, and we have also brandy, rum, gin, and whisky, which the men of old never heard of. *Brandy* is distilled from wines, but a great deal is made from fermented potatoes, to the spirit from which is added something to make it taste like true brandy. *Rum* is made by distilling fermented molasses,* a thick kind of treacle; much of this is made in Jamaica. *Gin* is made by distilling fermented grain, and is flavoured with juniper* berries and other things. *Whisky* is also made from grain but is flavoured in another way, namely, by being distilled over a peat fire, some of the smoke from which dissolves in it. Both rum and brandy are coloured with burnt sugar, and all of them are very often made in other ways, but sold for true spirits. For instance, Alcohol can be made from old rags, paper, or sawdust: sugar is first obtained from these by a chemical process, and then this sugar is fermented in the usual way. Alcohol thus obtained is called *silent* spirit, because there is no flavour to betray its origin. The strength of rum, brandy, gin, and whisky, as bought at shops and public-houses, varies a good deal, because very often water is added to them to increase the quantity, and other things (such as cayenne* pepper, &c.), in order to make them still taste as hot as before. However, you may reckon that spirits contain about an equal amount of pure alcohol and of water, and are therefore more than twice as strong as port and sherry. There are many other kinds of spirituous liquors made in other parts of the world, of which may be mentioned *sam-shoo*, made by the Chinese from rice; *arrack*, made from the same source in India; and *toddi*, from the juice of the date-palm.

One ounce of true or absolute Alcohol is contained in each of the following:—

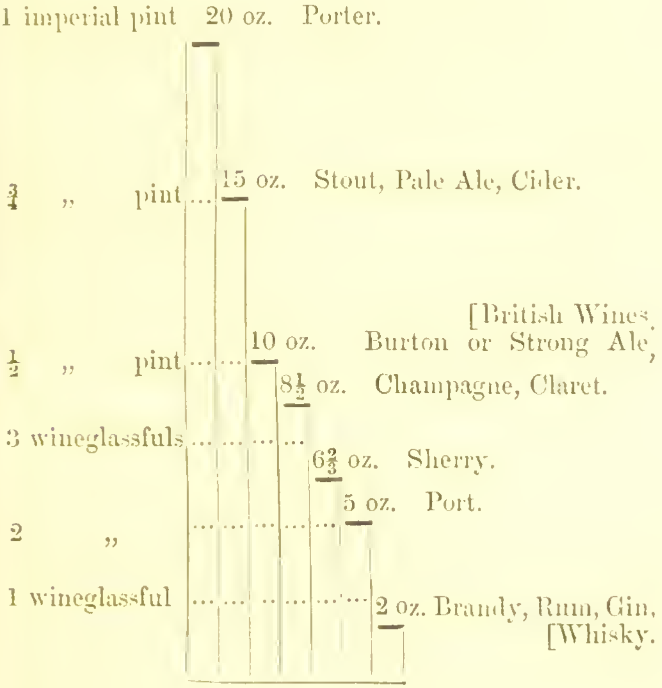


FIG. 8.

EXERCISE V.

1. What does beer contain?

2. How can Alcohol be taken away from beer and wine?

3. Which contains more nourishment, a loaf of bread or a gallon of beer?

4. How is wine made? What makes some wine red?

5. What are spirits? Mention some, and what they come from.

†6. Give the quantities of the various things in 1,000 pounds of beer.

†7. Why is beer not a good food?

†8. What are *must, fortified wine, and distilled spirits?*

†9. What does wine contain?

†10. Compare the alcoholic strength of *gin, port, sherry, claret, strong ale, cider, porter.*

CHAPTER VI.

On Alcohol.

A FEW words now about *Alcohol,* that which makes beer, wine and spirits intoxicating. You have learned that Alcohol is formed whenever any fluid or juice, which contains sugar, is made to ferment. Of course it has been present in all intoxicating drinks since they were first made, but no one knew what made them intoxicating until the process of distillation was invented, by which the *spirit of wine* was separated from the water and other things in it. For a long time it was a very great curiosity, and no one thought of drinking it except as a medicine. The old alchemists,* who first knew of it, thought they had discovered the *elixir of life*,* which they were always trying to find—something to cure every disease and make people live for ever; but they made a great mistake, for millions of people have been killed by it since it was first distilled. It was first called *Alcohol* about 200 years ago.

When bread is made by means of yeast, fermentation takes place; a very little Alcohol is produced, and also Carbonic Acid gas; and it is this gas which makes the holes in a loaf of bread. When the bread is baked, the Alcohol is driven off by the heat of the oven.

Alcohol in a bottle looks like water, but how different it is! Water has no smell or taste, but Alcohol has a peculiar smell and a hot, burning taste: indeed, it must be mixed with some water before it is possible to drink it. A fish can swim about in water, but if you put it into a basin of Alcohol it would be killed directly. It would kill a plant to moisten the ground with Alcohol. In fact, Alcohol has a tendency to kill all living things, and would do so unless mixed with much water. If you were to put some Alcohol, even with a good deal of water, into your eye, it would make it smart very much; we say it irritates the eye: in other words, Alcohol is an *irritant.* If it is swallowed, it irritates and inflames the inside just in the same way; and if enough is taken it sends the person to sleep, so it is called a *narcotic*,* which means "something which sends to sleep;" if sufficient is taken, the person never wakes again—he is poisoned; therefore Alcohol is called a *narcotic poison.*

Alcohol is not so heavy as water. *Four* pints of water weigh about as much as *five* pints of pure Alcohol. It is very difficult to get Alcohol quite pure; that is, without any water at all mixed with it. The Alcohol when quite pure is called *absolute** Alcohol; and if this absolute Alcohol is not closed up in a bottle it attracts moisture, or water, from the air. If you buy Spirit of Wine at a shop, you get what is called *Rectified** *Spirit*, of which about four parts are absolute Alcohol and one part water. There is another mixture of Alcohol and water which is called *Proof Spirit,* containing about as much water as Alcohol. It is called "Proof Spirit," because some years ago a good deal more money had to be paid on all spirits brought to England from abroad if there was more Alcohol in the mixture than water; so the Custom-house officers used to take a little and "*prove*" it. They proved it thus:—

Experiment IX.—They took a little gunpowder and put it into a kind of cup; then they poured some of the spirit on it, whatever it might be, whether brandy, rum, or gin; then they set fire to the spirit. Now, Alcohol is unlike Water in this also, that it will burn with a blue flame; so it will, too, even if some water is mixed with it: but, while the Alcohol burns, it dries up some of the water. If there is more water than there is Alcohol in the mixture, all the water is not dried up—some is left behind. If all the water is dried up, then, when nearly all the Alcohol has burned away, the flame comes down to dry gunpowder and explodes it. But if some water is left, it wets the gunpowder, and so the flame at last goes out, and there is no explosion. If there was an explosion, then the spirit was said to be *over proof*—that is, there was at least as much Alcohol as Water in it; if there was no explosion, it was said to be *under proof*. This was a rough-and-ready process, and is not used now.

When Alcohol burns there is not any smoke, because all the Carbon is easily oxidized, or changed into Carbonic Acid; there is, therefore, no black mark, or soot, left on a plate which is held over the flame [*Experiment V.*, p. 17].

Beer, if it is kept, and the air can get to it, turns sour. So does wine unless it is kept closely shut up in bottles, or unless some strong spirit of wine has been added besides that which is formed during fermentation. The reason of this is that, after the Alcohol has been formed, after a time another kind of ferment is formed, which acts on the Alcohol in much the same way as the yeast acted on the sugar. The Alcohol becomes oxidized, that is, it combines with some more Oxygen, and forms Acetic Acid, or *vinegar*. As the presence of Oxygen is necessary for this change to happen, therefore the air must be able to get to it. [The change which occurs can be easily seen by comparing the formulæ of Alcohol and Acetic Acid. Thus:—

$$\overbrace{C_2H_6O}^{\text{Alcohol.}} + \overbrace{2O}^{\text{Oxygen.}} = \overbrace{H_3C_2H_3O_2}^{\text{Acetic Acid.}} + \overbrace{H_2O.}^{\text{Water.}}\ ]$$

It is very clear, then, that no wine or beer would ever be made if men did not take a great deal of trouble to make it. God does not make it as He makes the dropping rain, the crystal spring, the flowing river, the salt sea. He makes the nourishing grapes, of which thousands of tons are eaten, either fresh, or dried to form raisins and currants. These are all His good gifts to men. Not that we ought to eat or drink all His good gifts: we must use our common sense and see if they are good to eat or drink. We do not eat the poisonous hemlock nor drink the briny sea. But the goodly luscious grapes contain a juice which never ferments and changes to Alcohol on the tree or in the grape; the grapes must be crushed and the juice pressed out before it will ferment and produce Alcohol. But even then our gracious Father will not leave the Alcohol to poison and intoxicate us. He will go on to change the poisonous Alcohol into the harmless and useful vinegar. But men take a great deal of trouble to prevent His doing this, and ought not to charge Him with sending wine and spirits to tempt and injure the creatures He has made.

EXERCISE VI.

1. What is "spirit of wine," and how is it obtained?

2. Mention some differences between Alcohol and Water.

3. What are "Absolute Alcohol," "Rectified Spirit," and "Proof Spirit"?

†4. What kind of poison is Alcohol said to be, and why?

†5. Why do beer and wine sometimes turn sour, and how may this be prevented?

†6. Is Alcohol a "good creature" of God? Prove your answer.

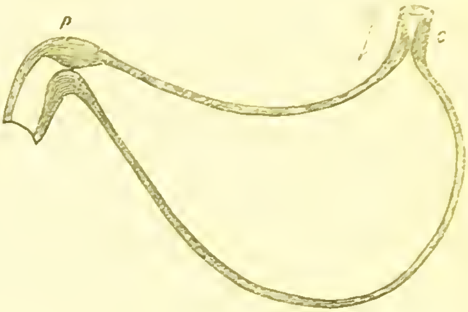
CHAPTER VII.

On the Process of Digestion.

In order that you may be able to understand how alcoholic liquors affect the process of digestion you must first know what this is. The "process of digestion" is the way in which our food is treated, after we have eaten it, so that it may nourish and strengthen us.

First of all you have to bite the food well with your teeth. This is to break it up into small pieces. The food, as you bite, becomes mixed with the spittle or *saliva,** and thus it is made soft so that you can swallow it easily. The saliva is a watery fluid, and contains something which acts as a ferment, like diastase, and is able to turn starch into sugar.

When the food is swallowed it is squeezed down a long tube or passage, called the *gullet,** [or *œsophagus**], into a kind of bag, called the *stomach.**



The Stomach.
FIG. 9.

This bag, or stomach, only fills a small portion of the part of the body which is often called "the stomach," but which also contains the intestine* or bowels, the liver, the kidneys, and other parts.

The food enters the stomach at *c* (Fig. 9) in the direction of the arrow, and, as soon as it has got in, the hole is squeezed together and closed so that the food shall not go back again. If the food comes up again we say we are "sick." As soon as the food gets in, the stomach begins to move about as though it wanted to squeeze it all out. The door at *c* (Fig. 9) is shut, so the food cannot go back: but there is another door at *p* (Fig. 9), and the food tries to get out that way; but it finds that tightly shut too, so it is obliged to go round and round in the stomach for a long time. After a while the door at *p* seems to get tired of being shut, and opens very slowly, so that first a little fluid can get out of the stomach, and then more and more, till at last, even if you have swallowed a halfpenny, or a cherry-stone, or any other hard thing, by mistake, the gate will open widely enough to let it go by.

But all the time the food is in the stomach it is becoming altered. On the inside of the walls of this bag (the "inner coat" of the stomach, as it is called) there are thousands of little tubes, too small for your eyes to see: from each of these tiny tubes, whenever anything goes into the stomach, comes a little drop of fluid, something like your spittle, but rather thicker. All the drops flow together and make a pint or more of what is called *gastric juice*,* or stomach juice. This juice of course mixes with all the food in the stomach.

This gastric juice is very useful, because it is able to dissolve meat, eggs, cheese, gluten, and all kinds of albumen. These things are moved about in the stomach for two or three hours to mix them with the gastric juice, until at last all the food is made quite soft, a kind of pap called *chyme*.* This change of hard food into *chyme* is part of the process of digestion.

But some things that are swallowed are either liquid already, as water and Alcohol, or, like sugar and salt, are easily dissolved in the fluid that we drink with our meals. These things do not want digesting, and get out of the stomach very soon, *without going through either of the gates.* This is because they can soak through the walls or sides of the stomach.

Experiment X.—Take a square or round piece of clean blotting paper, the thicker the better: fold it into four, and then open it a little so as to form a hollow vessel as in Fig. 10. Hold it over a tumbler and pour a little water into it: very soon the water will soak through and drop into the tumbler. If you had a bladder it would do the same, but not quite so quickly. The fluid in the stomach soaks through its inner coat in this way. But as it goes through the wall of the stomach the water meets with millions of little tubes, or pipes, called *blood-vessels* because the blood flows through them: it soaks through the walls of these little blood-vessels too, and so gets into the blood and mixes with it. The blood carries all the fluid away into larger tubes, right away from the stomach, so that it is never able to soak right through the stomach

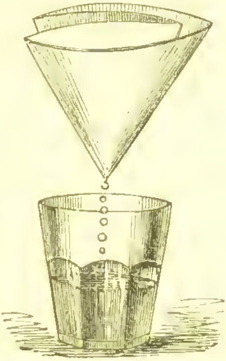


Fig. 10.

and get outside as it does through blotting-paper, at least not while we are alive. When we are dead, and the blood does not flow along the blood-vessels, water in the stomach can soak right through. Water, then, with whatever is dissolved in it, which thus soaks through the walls of the stomach into the blood, is said to be *absorbed** by the stomach.

In the process of digestion, therefore, the stomach has three duties:—1. To absorb all things that will dissolve in water and pass them into the blood. 2. To pour out gastric juice, by which albumen is dissolved. 3. To break up all the food and make it into a kind of pap, called *chyme*.

The starch and fat in the food are well mixed up, but not digested in the stomach. These, together with the altered albumen and some other things, pass out of the stomach through the gate *p* (Fig. 9) into the bowels.

Here the *chyme* is mixed with *bile*, which comes along a tube from the *liver*, and another fluid [called the *pancreatic* juice*] coming from the *sweet-bread* [or *pancreas**].

These are very useful in the process of digestion, but we need not learn about them now for this reason:—intoxicating liquors, when swallowed, go into the stomach and do some mischief there; but they are all absorbed into the blood and do not get into the bowels. So we have next to learn what these liquors do to the stomach and the food in it, and where they go to afterwards.

EXERCISE VII.

1. Where does the food go to when we swallow it?

2. What becomes of water or wine which gets into the stomach?

3. What is the use of the stomach?

†4. In what way does the stomach act on (*a*) meat, (*b*) sugar?

†5. How does alcohol get into the blood?

†6. What does *chyme* consist of, as far as you have been taught?

CHAPTER VIII.

Alcohol and Digestion.

We have now to consider the way in which Alcohol, when taken into the stomach by drinking it, affects the process of digestion. But you must remember that we are now speaking of a mixture of Alcohol and water. Wines and beer contain other things beside Alcohol, and some of these affect digestion, as we shall see presently; but now we ask, What does Alcohol do in the stomach? Of course the changes which it causes greatly depend upon how much water the Alcohol is mixed with, either before it is drunk or after it gets into the stomach; the more it is diluted * with water the less effect it has in the stomach; therefore weak drinks, like small beer and claret-and-water, do much less harm than strong wines and spirits. Again, if the stomach is full of food, any Alcohol which comes into it is further diluted by the food and gastric juice; therefore, alcoholic liquors do more harm to the walls or coats of the stomach if they are taken between meals, on an empty stomach, than if they are taken with food.

If some spirit and water is taken into the mouth it tastes hot, and if you held it in your mouth long it might take the skin off. If you held some in your mouth for a short time every day you would get used to it, and not feel it so much, but it would always irritate and inflame the mouth if strong and kept there long.

Just as the Alcohol irritates the mouth, so *it irritates the lining coat of the stomach.* But you cannot feel things in your stomach as you can in your mouth, and many people's stomachs are very much inflamed through drinking spirits, and they do not know it.

There was a man in Canada, whose name was Alexis St. Martin, who, in 1822, was shot so as to make a hole straight into the stomach. It was easy to see the lining of the stomach, and the food which was taken into it. A doctor looked in every day, and found that beer, wine, or spirits taken freely, but not enough to make him drunk, always inflamed the stomach, though the man felt quite well. When he left off taking any, the stomach became quite healthy again in two or three days.

If the alcohol were not quickly absorbed by the coats of the stomach, and sent away in the blood, much more harm would be done. Though you cannot feel with your stomach as you can with your mouth and tongue, yet there are *nerves* * in it by which you can feel pain there sometimes if all is not right. If you have eaten too much dinner, you may feel as if there was a heavy weight at your chest, or have a pain in your side; so also if you have swallowed a halfpenny, or eaten something too hard to digest. If you take some Alcohol and water it will sometimes take this pain, uneasy feeling, or uneasy sensation, quite away. Hence many people think that the spirit (perhaps brandy-and-water) has helped digestion. But they are wrong. It is true the pain goes away, but this is partly because the Alcohol *deadens the nerves of the stomach*, so that they cannot feel so well; and, partly, because the gate at *p* (Fig. 9) [the pylorus], as a result of this deadening of the nerves, does not squeeze so tightly, and lets the food get out of the stomach more quickly, but *before it is properly digested.* Of course this half-made chyme gives more work to the rest of the bowels, and injures them more or less.

[This action of Alcohol in deadening the sensibility of the nerves, and rendering them less able to convey impressions, is called an *anæsthetic* * action; a little chloroform * will produce the same effect. Alcohol may sometimes remove pain by checking spasm of the muscles of the stomach and bowels, but this relief can also be obtained in other ways.]

One result of the irritating action of Alcohol on the stomach is to cause more blood to flow to it, so that it becomes redder; just as brandy would make your eye red if some were dropped in. When there is no food in the stomach, its colour is pale; but when food enters in it becomes red; it blushes, as the face does, and in the same way—namely, by more blood flowing to it. This increase of blood in the stomach enables it to make more gastric juice just when it is wanted. Our food irritates the stomach just enough to produce this, and no more, if the stomach is healthy and the food of a proper kind. If Alcohol is taken as well as food, the stomach is irritated *too much.* If the Alcohol is taken every day the stomach gets used to it, and the food then does not seem to irritate the stomach enough, unless Alcohol, or some other irritating substances, such as pepper, mustard, or hot pickles, are taken with it. So, in some cases, when persons leave off taking beer at dinner, they miss it for a day or two, until the stomach gets to its natural condition again. If the stomach does not produce enough gastric juice by the natural irritation of proper food, there is something wrong. It is not wise to irritate such a weak stomach by Alcohol or other irritating things, because these do not remove the *cause* of the weakness; and, if that continues, they will soon lose their effect and have to be taken stronger. If a good horse one day begins to go about slowly, or becomes lame, it is not wise to whip it so as to *make* it go fast—it needs rest or medicine; but if you get into a habit of whipping a horse, very soon it will not go quickly without: it is best not to begin either to irritate the horse with a whip, or the stomach with alcoholic liquors.

In beer, and other malt liquors, you know that there are hops. These make the beer slightly bitter, and have an action on the stomach. The bitter part of the hop helps to increase the appetite, and would do this even if the Alcohol were all boiled out of the beer. But this, too, is not wanted by a healthy stomach, and soon loses its effect in the same way that Alcohol does.

There is also a way in which Alcohol often hinders digestion. (*Experiment XI.*)—Take an egg and break it; separate the white of the egg and beat up the white with a little water: now put some of it into a glass and pour some spirit of wine on it: it makes hard white flakes, which settle at the bottom. (*Experiment XII.*) —Now take the rest of the white of egg and water, and boil it, either in a glass test-tube over a spirit-lamp or in a saucepan on the fire. Again you have hard flakes thrown down. So you see that Alcohol hardens the albuminous part of the food—such as meat, egg, &c.—and makes these more difficult to dissolve in the gastric juice.

But the Alcohol also acts on the gastric juice itself, and makes this less able to digest and dissolve the food. So a healthy stomach takes longer to digest food with Alcohol than without it. Fortunately the Alcohol gets out of the stomach as fast as it can, and so less harm is done than otherwise would be the case.

Remember, then, that *alcoholic liquors never strengthen digestion* any more than a whip or spur strengthens a horse. If your digestion becomes weak as you get older, it is probably by doing, eating, or drinking something which you ought not. The best way, then, to get well will be to alter your bad habits.

If strong spirits are taken for a long time, they often cause disease of the liver. This is especially affected, because all the spirit taken out of the stomach into the blood goes directly to the liver before it is diluted with much blood. Here, again, the Alcohol irritates, and then causes inflammation of the liver. After a time the liver shrinks to half its size, and is then called "gin-drinker's liver": this often causes dropsy and death.

EXERCISE VIII.

1. Why do Alcoholic liquors do more harm when taken between meals, and why?

2. What does Alcohol do to the lining of the stomach?

3. What action does Alcohol have on albuminous food?

†4. How does Alcohol affect the stomach, (*a*) as to its movements, (*b*) as to its sensibility?

†5. How does Alcohol seem to help a weak stomach, and why is its action thus not really beneficial?

†6. How does Alcohol hinder the process of digestion, and what conditions increase its power of hindrance?

CHAPTER IX.

Alcohol in relation to Food.

It is necessary to say a few words on this subject, because many people seem to think that Alcohol, or the liquor which contains it, is very nourishing,—more so than most other things. This is a very great mistake. You know that in beer and wines there are other things besides Alcohol; in wines, especially, there is more or less sugar: this sugar, of course, is heat-giving food as much as sugar in your tea, but no more. So when people have lived a long time on beer or wine alone there is no doubt that they have been fed by the sugar.

But we want to know what becomes of

Alcohol after it gets into the blood. You know it goes through the liver, and possibly some of it stops there; but a good deal goes on with the blood to every part of the body: some of it soaks through the lungs and comes away with the breath, which often smells of Alcohol. Some of it is removed by the kidneys and a little by the skin. But the quantity which comes out of the body as Alcohol is not nearly as much as goes in. What becomes of it? At present we must say that nobody knows for certain. *It disappears,* and that is all we know. Some people think it is burned up and oxidized in the body as sugar is: there is something to be said for this, but also some things against it: we hope to know some day. What is much more important is to know whether the *result* of taking it is good or not, because it ought not to be called *food* unless it is *useful* to the body, or at least does more good than harm.

When sugar is oxidized or burned in the body it produces heat, and enables the muscles to do work and move the body about. The same amount of heat or work is always produced by the same amount of sugar, because it is always formed of the same number of atoms of Carbon, Hydrogen, and Oxygen, and always takes just the same number of atoms of Oxygen to change it into Carbonic Acid and water.

$$[\overbrace{C_{12}H_{28}O_{14}}^{\text{Grape-sugar.}} + \overbrace{24O}^{\text{Oxygen.}} = \overbrace{12CO_2}^{\text{Carbonic Acid.}} + \overbrace{14H_2O}^{\text{Water.}}.]$$

But if a similar quantity of sugar is taken and first broken up into Alcohol, Carbonic Acid, and Water, and then only the Alcohol is drunk, it is very clear that as much Carbonic Acid and Water cannot be made from the Alcohol as from the Sugar from which it was obtained, for some of these have been lost before it is swallowed.

[One atom of grape-sugar produces four atoms of Alcohol, and

$$\overbrace{4(C_2H_6O)}^{\text{Alcohol.}} + \overbrace{24O}^{\text{Oxygen.}} = \overbrace{8CO_2}^{\text{Carbonic Acid.}} + \overbrace{12H_2O}^{\text{Water.}}$$

eight atoms of Carbonic Acid instead of twelve, and twelve atoms of Water instead of fourteen, yet the same amount of Oxygen is used up. This may partly account for the diminution in the amount of Carbonic Acid in the breath after taking Alcohol.]

Even supposing, then, that all the Alcohol is oxidized, its value as food is not equal to the sugar, and it costs a great deal more.

Further, there is no *Nitrogen* in Alcohol: it is very certain, therefore, that the body cannot grow or be formed out of Alcohol: it will not make flesh, or bone, or brain, or blood; it could only be used to make fat with, and it is doubtful whether that is ever made out of Alcohol itself; people who drink much spirits get thin, those who drink much beer get fat and bloated, though it is not healthy to be fat, and their fat is not healthy fat; but this is due to the other things in the beer more than to the Alcohol it contains.

People who leave off beer often get thinner for a time, or altogether: sometimes they are frightened at this, but it is all the better for them. The Arabs, who never drink any intoxicating liquors, and who have much exercise, are strong and very muscular, with scarcely any fat. The hare, which runs about very much, has no fat; the lazy pig, which eats too much, becomes too fat to walk.

But while it is quite *possible* that some Alcohol may be burned in the body as fuel, we know that Alcohol, before it is got rid of and disappears, has such an effect on the nerves as to more than undo any good which might be obtained by burning it in the body. As a matter of fact, instead of making the body warmer, *it makes it slightly cooler,* and more so the more you take; so that in very cold weather, when you need more food to warm you, you should not take Alcohol, because it will make you colder than before.

The other use of heat-giving food is to enable you to do work by moving your muscles.

When you have more work to do you need more food. If Alcohol were useful for this purpose you would take more then than at any other time. But it has been shown that *Alcohol weakens the power of the muscles,* so that they cannot move such heavy weights. The more you take the less work you can do: so that you may even be unable to move your body at all and tumble down, far less be able to carry a sack of coals or wheel a barrow.

We may safely say, then, that *Alcohol is not useful as food;* it ought not to be called "food" any more than turpentine or paraffin, which can also be changed in the body, but injure it too.

EXERCISE IX.

1. Is there any food in beer and wine?—if so, what?

2. Where does Alcohol go to after leaving the stomach?

3. Can muscle (flesh) be made out of Alcohol? if not, why not?

† 4. Compare the possible food-value of grape-sugar and Alcohol.

† 5. Is Alcohol a useful food? Give reasons.

CHAPTER X.

On the Blood and its Circulation.

If you prick your finger, you know that a little drop of blood comes out. The blood is red: some ink is also red, but the redness is not caused in the same way. In the case of the ink the red colour is *dissolved* in water; in the case of blood, there are millions of small coloured particles floating about in a kind of water. These particles are called *blood-globules** (*globule* means *a little globe*), or *blood-corpuscles** (*corpuscle* means *a little body*). They are too small to be seen alone, unless they are magnified a great deal. They are not shaped like a round ball, but more like an india-rubber ball squeezed flat between your two hands; so that they seem round if looked at in front, long and thin if looked at sideways. They are so small, that 3,000 can lie side by side (as at *a*, Fig. 11) in a single inch, and 12,000, put one on the top of the other (as at *b*, Fig. 11), would only be an inch high. These blood-corpuscles are made of a kind of jelly, so that they can bend about as they float along. Each one by itself is only a very pale red colour, but there are so many millions of them that they look much redder when all together. They float along in the watery part of the blood like apples in a river. They are called *red* blood-corpuscles, because there are also some *white* ones, though not nearly as many as there are of the red. These *white corpuscles* (Fig. 12) are larger than the red, and change their shape as they float along.

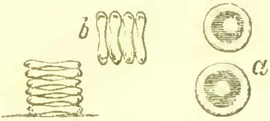


FIG. 11.

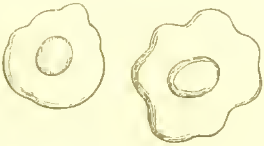
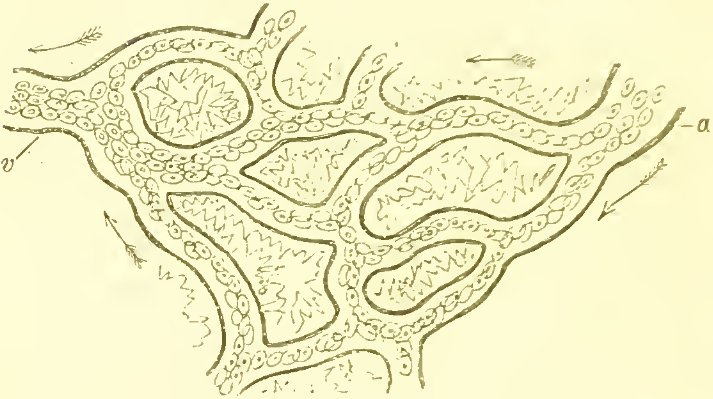


FIG. 12.

If the thin web between the toes of a live frog's foot is magnified very much, it is easy to see the blood moving about. You see in the figure that the blood-corpuscles do not go everywhere, but always move along certain channels, tubes, or pipes, which are called *blood-vessels.* These blood-vessels are of different sizes, but the smallest will just let one blood-corpuscle pass at a time. These very smallest blood-vessels are called *capillaries** (because they are fine, like hairs; *capilla* is the



Circulation of the blood in a Frog's foot.

FIG. 13.

Latin for "a hair"). You see that the blood, flowing the way the arrow points, comes along a larger tube, or blood-vessel, and that this divides, like the trunk of a tree, into branches, which also, in their turn, give off smaller branches still, until we reach the smallest capillaries of all. After the blood has passed through the capillaries, it gets into a larger vessel, formed by two or three capillaries joining together; then other vessels join this, and so on, and thus it gets bigger and bigger as we follow it on. The blood-vessel which brings the blood to any part (*a*, Fig. 13) is called an *artery*,* and the larger vessels which take it away (*v*, Fig. 13) are called *veins*.* The blood-corpuscles in the frog are not round, like ours, but *oval*, as in the figure.

If you could follow the blood, after it has passed through the capillaries and got into the veins, you would find the veins joining together and becoming larger, just as a river does when several streams flow into it. At last all the blood in the body is collected into two very large veins, and brought to the *heart.*‡

The heart is a hollow bag made of flesh or muscle (or, rather, it consists of two bags closely joined together). The blood flows into one side of it (*r*, Fig. 14), and is pumped or squeezed out of it again along another large blood-vessel (*p*, Figs. 14 and 15) to the *lungs.* It is forced

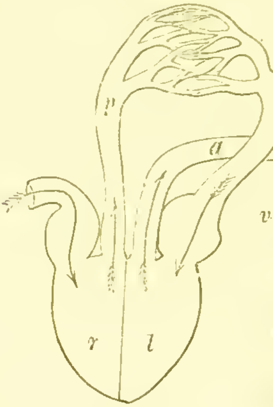


FIG. 14.

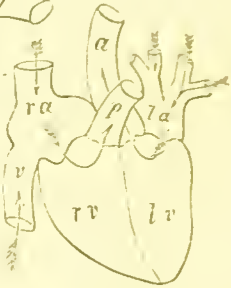


FIG. 15.

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‡ It will be well, if possible, to procure a sheep's heart, in order to impress this lesson on the mind.

through the lungs and comes back to the other side of the heart (*l*, Fig. 14), and when this gets full it squeezes the blood out again and sends it along the large artery (*a*, Figs. 14 and 15). This gives off branch after branch, dividing like a tree, and of course the main trunk gets smaller; at last all the branches, or small arteries, divide into capillaries as we have already described.

[The veins (*v*, Fig. 15) pour the blood from the body into the top part of the right side of the heart, called the *right auricle* (*ra*, Fig. 15): it then goes through a valve into the *right ventricle* (*rv*) and fills it; when full, the ventricle contracts suddenly and closes the valve, so that the blood must flow along *p*, the artery leading to the lungs: another valve prevents the blood flowing back again when the ventricle relaxes and fills once more. The artery to the lungs divides again into capillaries, which come in contact with the air which we draw in; then the capillaries unite as before and the blood is brought to the *left auricle* (*la*); then through a valve, opening downwards only, into the *left ventricle* (*lv*), which is much thicker and stronger than the right: this becomes full and then forces the blood out into *a*, through valves opening upwards only: the two ventricles contract at the same moment.]

When the heart squeezes the blood out it gives a throb or beat (which you can feel by putting your hand on the left side of your chest); it knocks up against the side. It forces the blood all through the body, and thus causes it to be always moving round and round, which is called the *circulation* of the blood.* The more quickly the heart beats so much quicker is this circulation. The heart beats more slowly, that is, not so often, when you are asleep, or lying down; more quickly when you are sitting, still more when you stand, and very much more quickly if you run or are excited. Sometimes you feel it thump very hard then, because it also beats more strongly. It beats more quickly in children than in grown-up people. Little babies' hearts beat about 120 times a minute, but in children it does so only about ninety times a minute.

You know now that the blood has to flow along tubes or blood-vessels called *arteries* to get to any part of the body. These arteries are not like stiff iron pipes, but elastic like india-rubber tubes, and can easily be made larger or smaller. If more blood is forced in they stretch first and then get smaller and press it on. [This movement of the arteries causes what is called the *pulse*, which you can feel at the thumb side of your wrist.] But they can also be made smaller when necessary, and then as much blood as usual cannot flow along them. [This is done by means of numberless rings of muscle round the arteries, and, of course, when these contract, they make the opening of the artery smaller.]

When less blood passes along any artery, the part which it supplies with blood gets paler. In cold weather the hands are sometimes pale for this reason, and the fingers may become quite white and "dead"; so also when people faint their faces and lips turn pale, the blood-vessels having *contracted*, that is, become smaller.

But if you stand in front of a fire the warmth *relaxes* or loosens the arteries, they become larger, more red blood flows along them, and your face becomes redder. When you blush, too, from shame, or from any other cause, the arteries relax, and you feel the hot red blood rushing into your face.

You were told that the blood *absorbs* the food or nourishment from the stomach and bowels, you now see that it can be carried in the blood to every part of the body.

The blood in the veins and right side of the heart is a very dark red colour, almost black. But if this dark blood is exposed to the air it becomes bright red. This happens to it in the lungs, into which we are drawing air day and night. It is the Oxygen of the air which changes the colour of the blood; the little red blood-corpuscles absorb, or take up, the Oxygen and carry it to every part of the body; in the capillaries the Oxygen is taken away from them for use, and they receive a load or cargo of Carbonic Acid instead, and thus the blood becomes dark red again. The blood-corpuscles carry this Carbonic Acid to the lungs, and exchange it for a load of Oxygen; and this goes on every moment of our lives.

EXERCISE X.

1. What is blood?

2. In what way does the blood get all over the body?

3. Of what use is blood?

†4. Describe the red and white globules of blood? What is the use of the red globules?

†5. What is the course of the circulation of the blood?

†6. What is the *pulse*, and what is the effect of the arteries contracting and relaxing?

CHAPTER XI.

The Action of Alcohol on the Blood, the Blood-vessels, and the Heart.

When Alcohol passes through the lining, or inner coat of the stomach, it gets inside the blood-vessels and mixes with the blood. The chief result of this, as far as we know, is that some of the little red blood-corpuscles are slightly altered; they become shrivelled, and are not able to carry the Oxygen and Carbonic Acid gases so well as before. They are not so useful as they ought to be. These changes, however, would not be seen unless a good deal of Alcohol had got into the blood. The more of it a person takes regularly, so much the more will the proper nourishment of the body be prevented.

But Alcohol mixed with the blood irritates the blood-vessels along which it flows. All the blood from the stomach passes along a blood-vessel to the liver. Here the blood-vessel divides again and again, until very fine vessels, called capillaries,* are formed. Their walls are very thin, and as the blood passes along, the substance of the liver all round takes away some parts of the blood to make bile. If there is any Alcohol in the blood, a good deal of it passes out of the blood-vessels here; and, therefore, if a person drinks much spirits the liver is almost sure to be diseased. The rest of the Alcohol in the blood passes on through the liver, and mixes with all the blood coming up from the legs and body, and so goes on to the heart; there again it mixes with much more blood from the head and arms; and thus the Alcohol is diluted twice after it passes through the liver.

But Alcohol has a very important effect upon the blood-vessels in another way. You know that the arteries can relax, that is, become larger; or can contract, that is, become smaller. It is by means of *nerves* that these changes in the size of the arteries are produced. If the nerves are cut or paralysed,* the arteries relax or stretch as much as possible, and allow much more blood to flow along them. If the nerves are only weakened a little, then the arteries relax, but not so much. If the nerves are stronger than usual, then the arteries become smaller—they contract.

When Alcohol has been taken, that which gets past the liver passes at last to the brain and nerves, and one of the first things which it does is to alter them so that the nerves have less control over the arteries; therefore the arteries relax and more blood flows along them. When a person, who is not accustomed to do so, takes any alcoholic liquor, this change takes place very easily and very soon: the effects of it are seen in the flushing of the face and the giddiness which even a little alcohol will produce. But it is not only the vessels of the face which thus relax or dilate. The arteries in other parts of the body relax also; and this is especially seen on the skin, which becomes redder, because it contains now more blood than usual. The little capillaries are stretched by the larger quantity of blood which the relaxed arteries allow to flow into them. If they are stretched very much or very often, they do not get quite as small again when the effect of the Alcohol goes off. Thus it is that those who drink a good deal of these liquors have red faces and red watery eyes: if they leave them off, their colour gets more natural again in a few days, and they look much healthier and better; this is because the capillaries recover themselves and become smaller.

Besides this weakening of the nerves which move the blood-vessels, Alcohol also affects the circulation of the blood in another way. This is by its effect on the Heart. Alcohol causes the heart to beat more quickly than before

This beat of the heart you know is produced by its contracting and squeezing out the blood, which is sent through the arteries to every part of the body. Each squeeze of the heart takes place more suddenly when Alcohol has been taken, so that the blood is forced out with a greater jerk: and more of these squeezes take place every minute.

When you are lying down your heart does not beat so fast as when you are running about, because the blood is not wanted to take nourishment to the muscles of your limbs when they are not at work. When you do hard work the heart has to work harder too in order to enable you to do it. When Alcohol is taken it makes the heart beat just as if you were doing hard work. The heart goes on beating day and night all your life, so that it does a great deal of work every day. It is reckoned that the heart of a man beats about 100,000 times in twenty-four hours, and every time it beats it squeezes out, or lifts up, about a quarter of a pint of blood. It has to force the whole mass of the blood through the blood-vessels, and, in doing this, the heart as good as lifts about 120 tons weight one foot high every day. Dr. Parkes counted how many more times the heart beats after taking Alcohol, and found that a fluid containing one ounce of absolute, or pure, Alcohol, makes the heart beat 4,000 times more than usual in twenty-four hours; two ounces of Alcohol make it beat about 8,000 times more; four ounces make it beat 13,000 times more; six ounces, 18,000 times more; eight ounces, about 24,000 times more. This shows how much unnecessary work the heart has sometimes to do. One ounce of Alcohol, contained in a pint of porter, &c. (see diagram, page 102) makes the heart lift five tons one foot high more than it would have done; two ounces make it lift ten tons; four ounces, about sixteen tons; six ounces, about twenty-two tons; and eight ounces, about thirty tons,—one quarter as much again as without any Alcohol. This excessive action of the heart is a great strain upon it and upon the blood-vessels also.

It is this increased action of the heart which has gained for Alcohol the name of *stimulant.** This word comes from the Latin word *stimulus*, which means a *spur*: just as a spur stuck into a horse makes him go faster, so Alcohol quickens

EFFECT OF ALCOHOL ON THE HEART.

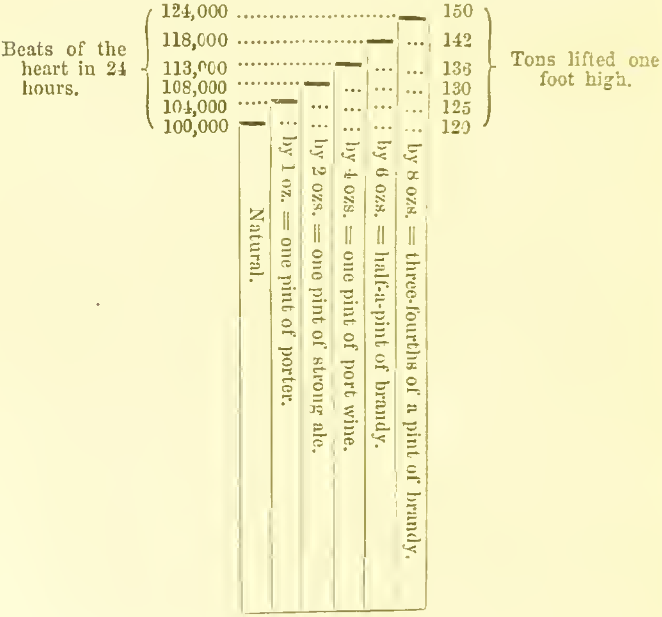

FIG. 16.

the action of the heart. But when the Alcohol has been used up or taken away, the heart, which has been *stimulated* to go more quickly, now goes more slowly for a time, because it is partly exhausted by its exertions. The harder it has been overworked the more rest it needs afterwards. Like an overworked horse it wears out more quickly than is natural, so that if the man gets old, it fails him when he needs it to do a little extra work in a time of illness or some other emergency.

EXERCISE XI.

1. How does Alcohol act on the blood itself?

2. What changes in the size of the blood-vessels are produced by Alcohol?

3. How is the Heart affected by Alcohol?

†4. What are some of the results of the action of Alcohol on the blood?

†5. Mention some of the consequences of the action of Alcohol on the blood-vessels.

†6. Describe the effect on the Heart of taking a pint of beer: is this injurious? if so, why?

CHAPTER XII.

On the Brain and Nerves.

If you wish to know how Alcohol acts on the mind and feelings you must learn something about them. Alcohol is only able to affect the feelings and thoughts of a man because it comes in contact with his brain and nerves, and alters them for a time. From every part of the body there are fine threads, called *nerves*, which can be traced upwards to the *brain* inside the head. As you follow them up you find that they join with others so as to make several bundles of nerves. These nerves are like telegraph wires leading from distant parts to a large town; if messages are sent along these wires a person in the town knows what is going on all round him. So when you touch anything, as in grasping a ball, a message goes along the nerve to the brain, and you know that you are touching it. If the nerve were cut across (as at *a*, Fig. 17) the message could not go, and you would not feel anything where that nerve led from; you would not know there was a ball in your hand. These nerves are called the *nerves of sensation* or *feeling* [*sensory nerves**]. But if you wanted to throw the ball you would send a message the other way, that is, down from your brain to the arm to make it move. This message would go along another nerve called a *nerve of motion* [*motor nerve**] (the dotted line, Fig. 17). All the different movements of the body, as walking, running, writing, are brought about by messages sent down from the brain. When a message

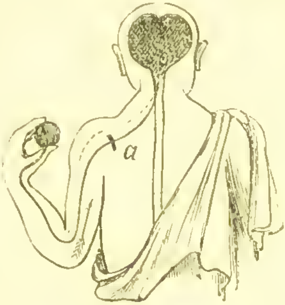

FIG. 17.

comes up to say that you are touching something, you may not notice it, either because you are asleep, or because you are thinking of something else. If you are reading a story as you walk along you feel the ground with your feet, but you do not notice it, or *perceive* it. But, while you do not *perceive* it with your mind, the nerves perceive it, and send an order to take the next step. You may feel and do a great many things without perceiving them with your mind: a bell may ring, or a person may speak, and you may not hear them; you may pass a shop and not see it: if you want to see and hear you must *attend* to it, or what is called *pay attention* to it. If there are two things before you, such as a pretty picture and the schoolmaster talking, you can *choose* which you will attend to, and if you give all your mind to one, you will not perceive or notice the other. When you were very little children, you had to *learn* to walk, and attend to every step; now you can walk without thinking about it. [Movements or actions which are done without the mind having to think and guide them are called *automatic* actions, because they are like the movements of a machine, going *by itself.*] Sometimes people walk about in their sleep; in this case part of the brain is asleep, and the *mind* does not perceive anything, and does not give any orders; but the messages are sent up along the nerves to another part of the brain, and do not go far enough to wake up the rest, and from this other part of the brain the messages are sent down to the legs to make them move.

There are some parts of the body which we cannot make to move, and cannot stop. We cannot make our hearts beat faster by just wishing them to do so, and we cannot stop them at all. [Such movements are called *involuntary*, while those that are made just when we choose are called *voluntary* movements.]

But the brain has to do with other things besides feeling and movement. If you are told some good news you are glad; if bad news you are sorry, and perhaps you cry: you are afraid of some things, and love or are pleased with others. People often cry or laugh, or say they are very glad, or afraid, or angry, or sorry, in their sleep, and do not know or remember anything about it. [These feelings of the mind are called *emotions*.] You can only make yourself glad or sorry by choosing to think about something which is likely to make you so. If something has made you laugh very much, how can you stop? You can try very hard, and perhaps may be able to do so; but the easiest way is to turn your mind to something else, or choose to think of something that is sad. When a person "*gives way*" to anger and to grief it is because he does not exert his will to turn his thoughts to something else—in other words, he does not *control* himself. It is like a horse running away with a cart, the driver of which is asleep or drunk, and does not guide or check him with the reins. Thus remember that *anger*, *fear, joy, grief,* &c. [the emotions] *are greater if the control of the will is weaker.* But while these things are then greater or more intense for a time, they are not so deep and lasting. A little child will cry one minute and laugh the next, then cry again or be angry, and soon forget it all. A child has to learn to control his feelings just as much as to control his legs; and since it is more difficult, it is longer before he can do so.

But besides all these movements and feelings [emotions] we also *think* [have *ideas*] with our brains. And we are able to guide or control our thoughts too. We can choose to think of something, and the thought comes; and when we choose to leave off thinking of it, we are able to do so; but the best and almost only way of doing this is by *thinking of something else.* If a wicked thought comes into our minds, it is very hard to drive it out; but it is much easier to think of something else which is good, and then the bad thought will pass away. The more we apply our minds to think of various things, the more easily we shall be able to do so. But sometimes thoughts [or ideas] are more active when we do not control them with our wills. When you *dream*, all sorts of thoughts come to you, wonderful thoughts sometimes: you think of splendid palaces, or beautiful birds, or ugly animals, such as you never thought of when you were awake; and all these thoughts, too, will run on, like an express train, from one strange thing to another, and you may seem to live a whole year, and see hundreds of things, in a few moments or minutes. You *imagine* you see and hear and feel these things. This power of thinking of strange things is called *imagination*, and it is more active when the control of the brain is less. When you wake up, and can guide and control your thoughts, all these wonderful things vanish, and you soon forget them.

Though you dream of many things which are *impossible*, you are never surprised while you are asleep. This is because your *judgment* is asleep, as well as the *will* by which you control your thoughts, feelings, and movements. You cannot perceive that things are wrong or impossible in your sleep, and so your judgment does not rouse up your will to make you do anything. [If your thoughts are very dreadful, as of a train rushing at you, you may feel that your *will* is asleep, that you cannot move yourself, and you wake up in a fright: that is called nightmare.]

Remember, then, that the *will* and the *judgment* are the highest and noblest parts of a man. By the *judgment* we are able to examine into things closely, and to decide what is best or most right. By the *will* we are able to choose which we please, the right or the wrong, the pleasant or the unpleasant; we can check or control our evil passions, and can encourage our good feelings; we can do this thing, and leave the other undone.

If a horse is trotting along gently the driver can guide him easily, but if he is running away at his topmost speed the driver cannot turn him, or only with great difficulty: at the same time, too, the driver will scarcely notice the people or houses he passes, because all his thoughts will be fixed upon the horse. So if your feelings are excited, if you get very angry, you will not be able to judge or think calmly of what is said or done to you, and it will be much harder to control or stop yourself than it was before. It is the same with all other thoughts and feelings by which people may be "carried away." All boys and girls should practise control over themselves, and this is only to be done by trying again and again, just as you learned to walk. *Self-control* is the highest power and the chief glory of the nature God has given us. Learn to use it.

[It is very important that you should remember the *order* in which we acquire control over our various powers. The helpless infant first learns to use his muscles: the child gets greater control over these, and learns to check his emotions: the perfect man is able to suppress or guide all his feelings, and also to study, to reason, or to think, about what he chooses; his judgment, too, becomes riper with age. But all these powers are only developed by practice, and many, alas! do not exert themselves to attain to the highest possible perfection of self-control.]

EXERCISE XII.

1. What are *nerves?*

2. What is the use of the brain?

3. What is the *will*, and how can it help us to get rid of bad thoughts?

†4. What are *automatic* actions? Give examples.

†5. How do we know that movements, emotions, and ideas, can take place without the consent or control of the will?

†6. What power does the will have over—
  (*a*) movements, such as walking;
  (*b*) emotions, such as anger;
  (*c*) thoughts, such as about a giant?

CHAPTER XIII.

The Influence of Alcohol on the Brain and Nerves.

When we speak of the influence of Alcohol on the brain and nerves we mean the changes in their actions which result when Alcohol has been taken. These changes are not quite the same in every person; partly because some can drink a great deal more than others, and partly because all brains are not quite alike.

One of the first changes which Alcohol produces in the body by its action on the nerves is to cause the heart to beat more quickly and the blood-vessels to increase in size and permit more blood to flow through them. The circulation of the blood is said to be *more active,* and the amount of blood in the brain is thus increased. One result of this quicker circulation and increased quantity of blood in the brain, is that the changes in the brain, which take place when we think, are more easily produced. The thoughts are said to flow more freely. The effect would be greater still if the red blood corpuscles were not slightly spoilt by the action of the Alcohol on them. This state of *excitement* is chiefly due to the increased flow of blood to the head, and is a consequence of the weakening [or partial paralysis*] of the nerves which make the arteries contract.

We want to know whether the mind is stronger or weaker during this state of excitement. In the first place, it is well-known that no workman who has to do any very delicate work, work which requires great steadiness of hand or quickness of perception, can do it so well if his nerves are at all excited, whether by Alcohol, passion, or any other cause. It has been proved that moderate doses of Alcohol render people less able to judge correctly of small differences in weights, and not able to perform mental arithmetic so quickly. So, also, Alcohol does not help a man to do things which require a great deal of thought and study. Sir Isaac Newton, the clever mathematician,* when he was writing his principal book, did not take any, because it prevented him from fixing his mind closely on his work.

What do these things teach us? They show that (1) Alcohol lessens a man's power to guide or control his thoughts. It *weakens the will*, the power of self-guidance and self-control. It does this in two ways; *firstly*, by making this self-controlling power actually weaker, and, *secondly*, by exciting the lower parts of the brain through the increase of their blood-supply, and so making them harder to control. It is as if the driver of a cart were partly stupefied, and the horses made to run away as well. But, though Alcohol really weakens the power of self-control, one man may often prevent another from seeing any difference in him, by making a little more effort, or, sometimes, a great effort. However, if the Alcohol had not been taken the effort would not have been wanted, and is very often not put forth.

We also learn (2) that Alcohol *weakens the power of perception and the judgment.* The man cannot perceive things so clearly and decide upon them so easily in this excited state. You would not like to be tried by a magistrate who was in a passion or a bad temper. In the book of Proverbs, chapter xxxi., verses 4 and 5, we read, "It is not for kings, O Lemuel, it is not for kings to drink wine, nor for princes strong drink; lest they drink and forget the law, and pervert the judgment of any of the afflicted." Alcohol thus *deadens the conscience*, because it makes it harder to think calmly of what we say and do, harder to "keep the door of our lips," and our hearts "with all diligence." Men are constantly thinking, saying, and doing things which they would not think, say, or do, but for having taken a moderate quantity of Alcohol. It does not take much to *alter* the brain and interfere with its natural action.

We have said that the thoughts and feelings [emotions] of the mind are at first more active because the circulation of the blood in the brain is increased. Another cause for this increased excitement is found in the lessened control of the will. The driver takes less notice of the horse and does not hold him in so much, and thus he can start off more quickly and follow his own course; he is more likely to run away if startled. So, also, when the passions or feelings are excited by Alcohol a man will take offence at or be pleased with trifles, such as he would not notice when quite sober. Thus, you see he has weakened his mind, and come down again for a time to be a foolish child. The tendency of Alcohol is always to lower men so that they become children in intelligence while they keep the vicious habits they have formed: but the Apostle says, "In malice" (that is, wickedness or vice) "be ye children, but in understanding be men" (1 Cor. xiv. 20). Wine makes men talk and act foolishly, as people often do in dreams. It makes them more like machines which cannot control themselves. *It degrades them.*

If a man, who has become excited by Alcohol, goes on taking more, before long the thoughts [or ideas] become less active, and the passions are then even more excited still. In that state the man is more dangerous, because he will not listen to reason or argument; he cannot understand it. He may commit murder while he is thus altered, and sometimes does not even know he has done it. It is of no use to talk to him. This condition lasts longer, and is more marked, in some people than in others.

By taking more Alcohol the control of the passions, too, becomes weaker, and the power to control and move the body is also weakened. The man cannot walk straight, but reels about; he cannot speak properly. With a little more he will not be able to move any part of his body, but lies like a log on the ground; he loses all feeling, too, and may not feel the pain even of a broken leg. The Alcohol has *gradually paralysed* him, beginning first with the highest and noblest powers of the mind, the control of the thoughts, and the power to judge between right and wrong; next, the control of the passions [the emotions] goes also; then the control of the movements of the body and the power of feeling [the senses] disappear. When he has come to this, he cannot take any more Alcohol: if he could, or if he has taken a great deal all at once, the movements of breathing, which go on even when we are asleep, are paralysed next; last of all the heart also ceases to beat, and the man is *dead.*

In all these cases the Alcohol does not *add* any power to the man, but disturbs the proper harmony or balance of the powers of the mind, and gradually weakens them from above downwards.

We must also notice the fact that Alcohol is in the same way able to deaden the feeling of some nerves that are over-excited. It is for this reason that so many people take it to get rid of uneasy feelings or slight pains. A better plan is to get rid of the *cause* of these pains, which are often the result of eating or drinking what is not good, or too much of that which is good.

There is also another point to be observed. If a person takes a very little Alcohol, the first time he does so it will have a great effect on him ; but if he takes it every day, at last it will not act in the same way, and he must take more to produce the same result : soon this, too, will cease to act. The nerves get *used* to the Alcohol, that is, they are gradually altered so that the spirit shall not be able to do so much harm. [*Tolerance* of the spirit is said to have been produced.] People who do not feel any effect from a glass of wine are not in a strictly natural state. But if they leave off their daily dose of Alcohol, they gradually get back to a natural state, and will be affected as at first.

EXERCISE XIII.

1. In what way does Alcohol affect the circulation of blood in the brain, and what is the result?

2. Why do intoxicated people often stagger and fall?

3. What kind of action does Alcohol have upon the brain and nerves?

†4. What influence do small doses of Alcohol have upon the highest and most delicate operations of the mind?

†5. Why do the passions or emotions of men become excited by taking Alcohol?

†6. What is understood by *Tolerance* of Alcohol?

CHAPTER XIV.

Alcohol and Hard Work, Heat, Cold, Health, and Length of Life.

We have now obtained some idea of the ways in which Alcohol is able to affect various actions of the body. We should expect that such a powerful agent would produce a perceptible effect on those who take it regularly. They ought to find some difference in their ability to do hard work, to endure fatigue, to bear the extremes of heat and cold, to resist disease. It would be likely to affect their length of life also. Does it do so? Let us see.

Hard Work.—There are many kinds of hard work, but all kinds require the use of the muscles, either of one part of the body or another. If one kind of hard work can be performed better without Alcohol, then all kinds will be, as far as the muscles are concerned. It is a matter of absolute certainty that all kinds of hard work, even the hardest, can be performed by those who never drink Alcohol. Miners, mowers, brick-makers, blacksmiths, glass-blowers, and men of many other trades, testify by thousands that it is possible to do the very hardest work with no other drink than water, or oatmeal and water. This is a fact which no one thinks of disputing, but which is often forgotten. Further, large numbers of men, who have made the experiment of abstaining altogether from beer and spirits, say that they can do more work with greater ease and comfort to themselves, and with less after-fatigue, than when they were accustomed to drink these things. The late Dr. Parkes made three soldiers march twenty miles a-day for six days: they were loaded with their rifles and other baggage. On two of the days they had whisky to drink, on two others coffee, and on the remaining two extract of meat dissolved in water. They all three declared that they found it most easy to march when they had extract of meat, and easier with coffee than whisky. The whisky seemed to help them a little for a time when they were tired, but when its first effect passed off they were more tired than ever. This result has been obtained in similar cases again and again, so that it is an established rule among medical men that Alcoholic liquors should not be given when there is any hard work to be done.

Heat.—But when those who work hard are also exposed to great heat, is the same rule best? If we are guided by facts in this matter (and we ought to be) there can be no difficulty in arriving at a correct conclusion. Whether we look at men who draw the white-hot iron from furnaces in the manufacture of armour plates; or who attend to the furnaces of steamships in such hot climates as that of the Red

Sea; or who are exposed to a tropical sun, as in India, the same rule holds good. The extreme of heat can be better endured without Alcohol than with it. It has been found that soldiers on the march in India who drink spirits are more liable to sun-stroke; as Sir Charles Napier has said, those who drink spirits have an "*ally*" of the sun in their brains.

Cold.—It is no less certain that extreme cold is better borne by abstainers from Alcohol than by those who drink it. This has been proved again and again by Arctic voyagers, whether visiting those regions for purposes of discovery, of trade, or of whale-fishing. Dr. John Rae, who has probably seen more of the Arctic regions than any other man of his position, was early convinced that Alcohol rendered both himself and his companions less able to stand the cold, and therefore gave it up. He is most emphatic in declaring that he and the men with him have been able to endure exposure to such cold for hours and days together as would have proved fatal had they partaken of any Alcoholic liquor. In those regions the thermometer is often fifty to sixty degrees below freezing point, and it is almost certain death to be exposed to such severe cold if Alcohol is partaken of even in moderate quantities. The men who, in the winter, trap animals in the Hudson's Bay territory for the sake of their skins, are obliged to abstain on their journeys for this reason alone, since many of them drink spirits when they dare to do so. The lumbermen of Canada who go out in gangs to spend the severe winter in the woods cutting down trees, which are floated down the rivers when they melt in the spring, are absolutely forbidden to take any spirits with them, lest, being tempted to drink them, death from the cold should follow. Alcohol, as we have seen, helps to cool the body by bringing the warm blood to the surface of the skin, and in other ways, and this is why it is so dangerous. It does not "keep out the cold"; *it lets out the* *heat.* By at first making the skin warmer for a time, and deadening the nerves, it renders the cold less perceptible, and necessary precautions are not taken against it.

Health.—It may readily be believed that, if Alcohol diminishes the ability of resisting heat and cold, it will also prove a powerless defence against bad weather, ague-poison, and hardships of all kinds. Such is, undoubtedly, the fact. Dr. Parkes discovered that, during the march to Coomassie, the capital of the Ashantis, in Western Africa, those who abstained from alcohol had less fever, and less illness of other kinds, in proportion to their number, than the rest, who drank very moderately. That these were really moderate-drinkers is known for certain, because there were no public-houses on the route, and the men had only a wineglassful of rum each day, which was served out every evening. The total-abstaining soldiers in India, of whom there are now nearly 10,000, have considerably less illness among them than the others, while they can do just as much work, if not more. But we need not go to foreign countries to discover that the use of Alcohol renders people more liable to disease and prolongs their illnesses. Medical men all agree that it is a great advantage to a sick person to have been a total abstainer, and it is well known that abstainers recover from accidents which are fatal to those who drink much Alcohol. Brewers' men, especially, though they often look so big, are very bad patients, and are liable to die from very slight causes.

Length of life.—If there is less disease among abstainers, we should naturally expect that their practice tends to lengthen their life, or, more correctly, that drinking Alcohol shortens life. This has been proved beyond a doubt. Publicans, as a rule, die earlier than any other class of men, even those whose trade or calling is very dangerous, such as railway porters and miners. Life assurance offices have found that the average length of life of total abstainers is greater than that of the drinkers of Alcohol. Some people say they do not believe that strong drink shortens life, because they know some old men who drink a great deal, and also, perhaps, some abstainers who have died young. But it would be just as sensible to say that war cannot be dangerous because there are some old soldiers who have never been wounded. Abstainers and non-abstainers die at all ages, but more of those who do not drink any Alcohol live to old age, than of those who do. Hence it is probable that if you abstain from all intoxicating drinks you will live longer than if you take them. [Perhaps the most important change which Alcohol produces in the body, and which often leads to disease and death, is that called fatty degeneration,* by which the walls of the blood-vessels and the substance of the heart are much weakened. When this is the case the blood-vessels often burst in the brain, or elsewhere, and apoplexy,* paralysis, and perhaps sudden death, result.]

Those who never take Alcoholic drinks are perfectly safe from all the disease which these produce, and from all the evils to which they lead. They never miss them or feel they need them, any more than women desire to smoke tobacco, or Englishmen to smoke opium. Science and experience, therefore, confirm the wisdom of the words of Solomon, "Wine is a mocker, strong drink is raging, and whosoever is deceived thereby is not wise." "Look not thou upon the wine when it is red, when it giveth his colour in the cup, when it moveth itself aright. At the last it biteth like a serpent and stingeth like an adder."

The best possible advice which can be given on this question of drinking Alcohol is—NEVER BEGIN. Thousands have bitterly repented that they ever learned to drink intoxicating liquors, but no one has regretted that he never touched them.

EXERCISE XIV.

1. Can hard work be done without Alcohol? Give examples.

2. Does Alcohol help men to bear heat and cold? Give examples.

3. In what ways does "Wine" "deceive" people?

†4. Give some reasons why abstainers can do hard work with greater ease than those who drink Alcohol.

†5. Why is Alcohol injurious in very hot and also in very cold climates?

†6. Mention some ways in which Alcohol produces disease, and shortens life.

CHAPTER XV.

The Cost of Drinking Alcoholic Liquors.

THERE is an old proverb which says, "You cannot eat your cake and have it too." Suppose there are two families, whom we will call Smith and Jones. In each of these families there are the father, mother, and three children. Each of the fathers earns thirty shillings a week. They have to pay the same rent, namely, five shillings a week. Mrs. Smith and Mrs. Jones are both very good and careful mothers, who try to keep their children tidy and their houses clean, and make the most of the money which their husbands give them. If you call on Mrs. Smith, you find that she has just bought a nice new teapot and a set of tea-things; and, because the weather is becoming cold, she has purchased a woollen comforter for each of the children and a warm shawl for herself. She will tell you that she is saving some money every week to buy a great-coat for Smith, and another blanket for Johnny's bed. "Smith is a good husband," she adds, "and brings me home all his wages."

You go in to the next door and see Mrs. Jones. She is clean and neat; but you hear Robert saying, "Mother, please buy me some new boots; these old ones are quite worn out and let the water in." His mother replies, "I wish I could, Robert; but I shall only have just enough money to pay the rent this week, and Sally must have a new frock because she cannot go to school without, and Billy has no socks to wear. What I am to do I don't know at all." On looking round the room you see that many other things are wanted too. Cups have been broken, so they have to make shift with tin mugs. One or two broken panes of glass are covered over neatly with brown paper: the whole house is not so comfortable as the other, and Mrs. Jones and the children are thinly clad.

Why is there this difference between the two families? The reason is that Mr. Jones is not a total abstainer, but spends several shillings a week on beer and spirits for himself, and in treating his fellow-workmen. He is not a drunkard, but at the end of each week he has a long score to pay off at the public-house, and can take home only part of his wages to his wife and children; for the part spent at the public-house he has nothing afterwards to show. The Smiths have not wasted anything on beer or spirits, and so they are able to buy many useful things week after week.

Nearly £150,000,000 are now spent in this country every year on alcoholic liquors—that is on beer, wine, and spirits. About £30,000,000 of this large sum is paid back by the brewers and publicans to the Government; but it all comes out of the pockets of those who drink these things. There are about 180,000 persons engaged in making and selling strong drink. If that were not allowed (and it is not permitted in some parts of America) these people would have to work at some useful trade, which would make other people richer; while engaged in their present trade they not only do no good, but make many others idle, poor and miserable, and a burden to their friends.

Suppose the whole of the counties of Kent, Surrey, and Essex were covered with waving corn. There are rather more than two and a half millions of acres in these three counties. About thirty bushels of corn are produced by each acre of land, so that nearly eighty millions of bushels could be grown in these three counties. If, when all this waving corn was ripe for harvest, men were to take torches and set it all on fire for the pleasure of seeing such a huge conflagration, should not we all be very angry, and feel that such wanton conduct was both foolish and wrong? Yet this is about the quantity of grain or produce which is destroyed every year to make beer and spirits. Of course it is barley that is thus destroyed, but if barley were not grown for this purpose the farmers might grow wheat or other crops for food. If the eighty million bushels had been all wheat, and this had been ground into flour, 1,200,000,000 four-pound loaves could have been made with it. This would have given about 190 loaves to each family, enough to feed them for more than four months.

If all this grain had been burned that would have been the end of it. We should have been so much poorer, but, when all was over, we could soon make up for the loss with care and hard work. When the grain is turned into beer and spirits that is by no means the end of it. Having made it into intoxicating drink, the best thing that could be done with it would be to burn it up, or pour it into the sea. Do you ask the reason? It is this: the beer and the spirits now injure the bodies of many people, destroy many lives, cause much waste of time, much drunkenness, much poverty, much madness, much crime, and ruin many souls for time and eternity !

This kind of drink causes many men to waste their time, or makes them too ill to work, and so they cannot earn as much money as they otherwise might. This makes us all poorer, even if we are abstainers, because the more work our countrymen do, the richer the nation is, and the more comforts we can afford to buy.

Again, the drunken habits of some people often ruin many others ; their wives and little children often suffer much, and even die for want of proper food and clothes, or a decent house to shelter them. Again, drinking intoxicating liquors is the cause of nearly nine serious crimes out of every ten. In consequence of this we are obliged to have many more gaols, judges, and policemen, and all these cost a great deal of money. Hundreds of poor idiot children are born, and at least twenty madmen out of every hundred have lost their reason through drink. All this waste of money and drink-caused idleness make and keep thousands poor who might have been well off, so that three-quarters of the workhouses would not be wanted but for drink.

Again, Alcohol is the cause of large numbers of accidents in town and country, on the railroads and in the fields; fires, wounds, shipwrecks, causing pain and death in every form, both to the innocent and the guilty. Above all, this drink is the great hindrance to every good work, to education, to all that seeks to raise the mind and the soul to decency, to virtue, and to God.

Ought we not to do all we can to stop such a dreadful curse? If any one could make cholera-poison and sell it to all who liked to buy, telling people it would do them good in moderation, we should all call him a horrible villain—although the stuff might be nice to taste—and we should very soon stop him; yet cholera would never do so much harm as Alcohol; it would never make men criminals, nor cause them to lose their souls. Alas! many have never realised the harm they do in making, selling, and encouraging the use of intoxicating liquor, this great cause of misery and sin!

The evil may be seen by a striking comparison. It has been reckoned that during the last thirty years all the wars in Europe and America have destroyed 2,500,000 lives and have cost about 3,000,000,000 pounds sterling. During the same time Alcohol has been the cause, one way or another, in Great Britain and Ireland *alone*, of at least 1,800,000 deaths, and perhaps of many more, and the cost of the liquors has been about £3,000,000,000. It has been also reckoned that for every pound that is spent another pound is lost or never earned so the loss to the nation in thirty years, in money, has been about £6,000,000,000!

CHAPTER XVI.

Total Abstinence or "Moderation"?

THE late Dr. Parkes has written thus:—"If Alcohol were unknown half the sin and three parts of the poverty and unhappiness would disappear from the world." This is quite true. It does not mean that there would be no crime and no sin anywhere without Alcohol. No, it means just this: that at the present time, and in countries like England, where there are so many influences on the side of all that is good and checking all that is bad, these would make the people virtuous and happy if Alcohol could be removed out of the way.

But Alcoholic drinks do not do any harm unless they are drunk; then they make people think, say, and do things which they would not have thought, said, or done otherwise. When this happens it is a plain proof that the person's brain has been affected by the Alcohol; this is *intoxication,* whether it is produced by a wine-glassful, a bottle, or a gallon.

Drinking leads people very often into *bad company;* and bad men and women when they begin to drink are sure to use bad language and commit sin. All the worst characters of a town are sure to be found at one time or another in the public-houses.

If the use of Alcohol leads into such company, and produces such sin and misery, it must be much better not to have anything to do with it ourselves, and not to encourage others to use it. Some people take it because they think it necessary for their health; this is a mistake, as we have seen. But many more take it for a different reason. A gentleman was once trying to persuade another to give up his wine, and used all kinds of argument for the purpose. At length the other said, "Friend, I cannot answer your arguments, and I will become a total abstainer at once if you will prove to me one thing more." "What is that?" said the gentleman, rubbing his hands, and thinking he should soon make a convert. "Just prove to me," said he, "that I don't *like* it."

This is the secret. Men give all kinds of reasons for drinking; they say that moderate drinking is best; that they cannot do without their beer or wine; even that it is wrong to refuse to drink it; but if these drinks tasted like those really good creatures of God, castor oil and jalap, no one would drink a drop or take a morsel unless they were obliged.

If you have never tasted these things they are not nice to you, and you would most likely think them nasty. You would never wish for such things, nor take them, if you were not tempted to do so by the example or the words of others. You are free now from the chain of this habit of drinking. If you once begin you will soon be bound with the same chain as so many others are, a slavery from which you either will not want to be free when you can be, or may not be able to escape from when you would.

Do not think that because you can soon get to like strong drink, therefore it was intended for a beverage. Horses, donkeys, pigs, and monkeys can be taught to like it as well as men; but it is good neither for them nor you.

If it were the fashion here, as it is in China and India, to smoke opium, we should no doubt come to think it just as nice and just as necessary as do many persons in those countries, but we know it to be a most dangerous practice and a very bad habit; it is, therefore, foolish to begin either one or the other. There are no men or women to-day, who have resisted all temptation, and firmly refused to taste a drop of alcoholic drink, but are thankful now—yes, profoundly glad and thankful—that they were enabled to do so. You will be thankful, also, when you grow up, if you do the same.

It is *quite* certain that if all the boys and girls who read this book resolve never to taste any beer, wine, or spirits on any occasion, *some* of them will be saved from a drunkard's life and a drunkard's awful death. No one can tell which of you it would be; but if each one who dreads the very thought of such a fate always refuses to drink these things, then that one can say without fear of mistake, "It cannot, it will not, be I."

You will never be asked to become a drunkard, but many will ask you to take a little *in moderation*, and some may even try to persuade you that this is better than total abstinence. The danger of such advice lies in this, that nobody can say where "moderation" ends and drunkenness begins, and so hundreds and thousands become drunkards, and have an irresistible craving appetite for drink created in them, before they are aware of it, and while they only mean to be moderate drinkers.

A dozen boys once ran out into the playground of a school. There was a grand talk as to what they should play at. At last one of them said, "See that little window high up in the side of the house all by itself; let us try who can throw a stone nearest to it without breaking it." This was splendid fun, so each took up a stone and began to throw. Some were far away, but others struck the wall very close to the window. At last, one unlucky boy threw a stone right through it. Crash went the glass, and out came the master. "What did you do that for?" cried he. "Please, Sir, it was an accident, I didn't mean to hit the window; we were trying not to hit it," answered the boy. "You all deserve blame," said the master, "for if it was by an accident that one stone went through the window, it was only an accident that all the others did not do so too."

If it is better to take Alcohol than not to take any, it must be quite lawful to take as much as you can without becoming intoxicated. Thousands, nay millions, have thus been lured on to destruction. Everyone who takes intoxicating liquors runs this fearful risk; and it is often altogether an accident, that is, beyond their own control, whether they become drunkards or not. Can it be worth while to run this risk when you are quite happy as you are? Can it be right that those who are now innocent of any such vice should be made discontented with their safe and happy ignorance either by precept or example? In this case it is most certain that

"Where ignorance is bliss, 'tis *folly* to be wise."

Even if it were quite certain that one of you could take a little, and would never take what is called "too much," it would still be a good thing to abstain *for the sake of others.* Boys and girls, as well as men and women, imitate each other. Some will drink just because you do. They see you seem to be safe (at present); they think they will be safe also. Some of them will have the craving for Alcohol excited in them, and will perish miserably. Your example will have been the means of their ruin. If you had set an example the other way, they might not have been lost, or, if they had, you would not deserve the blame.

Some people say that, by having the temptation to drink too much, and resisting it, the moral strength is increased. You are not commanded, and no one is obliged, to drink strong drink, and so encounter the risk of temptation to excess. You pray every day, "Lead us not into temptation," and ought not to run into it. If you know that there is temptation for you in a certain street, or house, or room, or glass, the Scripture says, "Avoid it, go not by it: turn from it, and pass away." You will have many temptations which you cannot avoid, and these must be resisted. You ought not to tempt yourself, nor to tempt others, with intoxicating liquors. The temptations about Alcohol which are to be resisted are the temptation to make or sell it in order that you may become rich through the weakness, misery, and vice of your fellow-creatures; and the temptation to drink a little of it.

Alcohol is unnecessary for health, life, or true pleasure: therefore touch it not, and the next generation of men and women will be more sober, more healthy, more happy, than the present.

APPENDIX.

DEFINITIONS.

These are given to enable those who have no one to help them to understand the more difficult words.

Note.—The pronunciation of the words is given by means of Mr. Ellis's *Glossic.* In this method of spelling every letter or diphthong always has the *same* sound, namely, that which it most commonly has in ordinary spelling. The following are the sounds given to those single or double letters which have usually more than one:—G, as in *gain;* Th, as in *thin;* Dh, as *th*, in *then;* Zh, the sound of *g* in *rouge;* Yh, the sound of *h* in *hew;* A, as in *bat;* Aa, as in *baa;* Ai, as in *bait;* Au, as in *caught;* E, as in *bet;* Ee, as in *feet;* Ei, as in *height;* Eu, as in *feud;* I, as in *fit;* O, as in *cot;* Oa, as in *boat;* Oo, as in *fool;* Oi, as in *foil;* Ou, as in *foul;* U, as in *but;* Uo, as *oo* in *foot.*

Lay the stress on the first syllable unless otherwise directed. Stress is marked by a dot (·) after a long vowel or diphthong, or after the first consonant following a short vowel.

Absolute Alcohol (absoaleut Alkoahol). Pure alcohol not mixed with any water.

Absorbed (absau·rbd). Soaked up.

Acetic Acid (asee·tik asid). Is contained in vinegar: made by the oxidation of alcohol.

Albumen (albeu·men). A substance containing carbon, hydrogen, nitrogen, sulphur, and oxygen: animal albumen is found in meat, &c.; vegetable albumen in seeds, &c.

Alchemists (alkimists). Men who searched for a method of turning metals into gold, for a universal remedy for disease, and similar things.

Alkali (alkalei). A substance able to unite with acids and remove their sourness.

Anæsthetic (aneesthet·ik). That which takes away feeling or sensation.

Apoplexy (apopleksi). A disease in which there occurs sudden insensibility, generally due to the bursting of a blood-vessel in the brain.

Artery (aaturi). A vessel, or tube, conveying blood from the heart to any part of the body.

Automatic (autoamat·ik). Having the power of moving itself, or of happening without the guidance of the will.

Barm (baam). Another name for yeast or leaven.

Blood corpuscles (blud kaurpus·kulz), or

Blood globules (blud globeulz). Very small bodies which float in a white fluid, and with it form the blood. Most are red (straw-coloured by themselves), but some are white.

Capillaries (kapil·uriz). The smallest tubes into which the arteries divide, and which unite together to form veins.

Carbonic acid (kaabon·ik asid). A gas soluble in water, formed when anything containing carbon is burnt or oxidized. CO_2.

Carbonate (kaabonait). A carbonate of anything is formed when carbonic acid unites with it.

Casein (kaisicen). A nitrogenous substance found in milk, and which forms curds and cheese.

Cayenne (keien·). A pepper obtained from the Capsicum plant.

Chloroform (klaurroafaurm). A white fluid, which causes insensibility when breathed for a short time.

Chyme (keim). The mixed-up food after it has been digested in the stomach.

Circulation (serkeulai·shen). The movement of fluids through tubes or blood-vessels.

Combustion (kombus·tyen). A burning up.

Couching (kouching). The spreading out of malt to dry.

Crystals (kristulz). The shapes which many substances, such as sugar, salt, &c., often take. There are many different forms.

Dextrin (dekstrin). A substance also called British gum: it is midway between starch and sugar.

Dextrose (dekstroaz). A kind of sugar found in sweet fruits: it is seen sometimes on candied raisins and French plums.

Diastase (deiastais). A substance formed in growing seeds, which is able to change starch into sugar.

Diluted (deileu·ted). Weakened by the addition of water.

Dissolved (dizol·vd). Taken up by a fluid, as sugar is by tea, and salt by water.

Distillation (distilai·shen). A process by which spirits of wine can be separated from water;

the two are heated, and the spirit comes away with the first steam that rises; it is made to pass into a cold place, and falls in drops.

Elixir of life (eelik·sir). A substance which the old alchemists searched for, and which they supposed would prolong life very much.

Emotions (eemoa·shenz). The feelings and passions of the mind; such as fear, joy, grief, anger, love.

Fatty degeneration (fati dijen·urai·shen). A change which often occurs in old people and drinkers of Alcohol, by which muscle and other parts of the body gradually turn into fat and become soft and weak.

Formula (faurmeula). In chemistry it means the letters and figures by which the composition of any substance is described, as CO_2 for Carbonic Acid.

Fortification (faurtifikai·shen). To *fortify* a wine is to add more alcohol to it, and fortification is the process of adding it.

Gastric Juice (gastrik joos). The fluid which is poured out by the stomach when food goes into it, by means of which meat and albumen are digested.

Gelatin (jelatin). A substance found in the bones, hoofs, skins, gristle, and other parts of animals. It contains nitrogen.

Glucose (glookoaz). A kind of sugar found in fruits, honey, &c.

Gluten (glooten). A substance found in wheat and other seeds. It contains nitrogen.

Gullet (gulit). The tube down which the food passes into the stomach: the Latin name for it is *œsophagus* (eesof·agus).

Hydrogen (heidrojen). An invisible gas which unites with Oxygen to form water.

Intestines (intes·tinz). The long tube or passage along which the food goes after it leaves the stomach.

Involuntary (invol·unturi). Something which happens in the body without the action or influence of the will.

Juniper (jeunipur). A tree or shrub the berries of which contain a kind of oil with which gin is flavoured.

Lactose (laktoaz). A kind of sugar found in milk.

Laevulose (leeveuloaz). A kind of glucose, or sugar, which does not crystallize.

Magnified (magnifeid). Made to appear larger by means of a microscope.

Malt (mault). Grain which has been first made to sprout a little, and then has been heated so as to stop its growth.

Maltose (maultoaz). A kind of glucose, or sugar, which is formed from the starch in grain when it sprouts.

Mathematician (mathimatis·hen). One who understands mathematics, which has to do with numbers and the measurement of all things.

Molasses (moalas·iz). The dark syrup which drains from the crystals of sugar when the boiled juice of the sugar-cane is cooling—treacle.

Motor-nerve (moatur nerv). Nerves by which the muscles are made to move the body.

Muscles (muselz). The red flesh that is attached to the bones, and moves them when we desire it.

Narcotic (naakot·ik). That which stupefies or sends a person to sleep.

Nerves (nervz). White cords, or threads, which pass from the brain to all parts of the body.

Nitrogen (neitrojen). A kind of gas which forms four-fifths of the air. Its symbol is N.

Nitrogenous (neitroj·inus). Containing nitrogen, generally combined with other things.

Œsophagus (eesof·agus).—See *Gullet.*

Oil of Vitriol (oil ov vitriol). Strongest sulphuric acid.

Oxygen (oksijen). An invisible gas which forms a fifth part of the air: nothing can live or burn without it. Its symbol is O.

Oxidized (oksideizd). When Oxygen unites with other substances they are said to be *oxidized,* or that *oxidation* is going on: when oxidation occurs heat is always produced, and sometimes light also.

Pancreas (pankreeas). The sweetbread of animals. It produces a fluid called the *pancreatic juice* (pankreeat·ik joos).

Paralysis (paral·isis). A state in which the will cannot make the muscles contract and the body move; it happens when the nerves are cut or there is some injury or disease of the brain or nerves.

Paralysed (paraleizd). Applied to limbs or muscles when the will cannot move them.

Phosphorus (fosfoarus). A substance easily set on fire; one of the materials of the body.

Proof-spirit. A mixture of nearly equal quantities of absolute alcohol and water.

Pylorus (pailoa·rus). The opening through which food leaves the stomach.

Quassia (kwoshyer). The wood of a tree, which has a very bitter taste.

Rectified spirit (rektifeid). Absolute alcohol mixed with a little water.

Saliva (salei·ver). Spittle.

Sensory nerves (sensuri nervz). Nerves which enable us to feel, see, hear, taste, and smell.

Soluble (soleubl). Able to dissolve in water, or some other fluid.

Stimulant (stimeulunt). That which rouses the body as a spur does a horse.

Stomach (stumuk). A kind of bag into which the food passes, and in which it is digested.

Sucrose (seukroaz). A kind of sugar found in the sugar-cane, maple-tree, beet-root, &c.

Sulphur (sulfur). Brimstone. Its symbol is S.

Sulphuric acid (sulfeu·rik asid). A burning or corroding acid fluid, formed by the oxidation of sulphur.

Symbol (simbl). A letter, or letters, standing for some substance : symbols are used by chemists to show what things are made of.

Tartaric acid (taatar·ik asid). A white sour powder, or crystal, obtained from grapes.

Thermometer (thermom·itur). An instrument by which heat is measured.

Veins (vainz). The blood-vessels which convey the blood from all parts of the body to the heart.

Voluntary (volunturi). Something which happens by the choice and guidance of the will.

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